Muelleria

Plant and Fungal Taxonomy & Systematics

Vol 28(1) 2010

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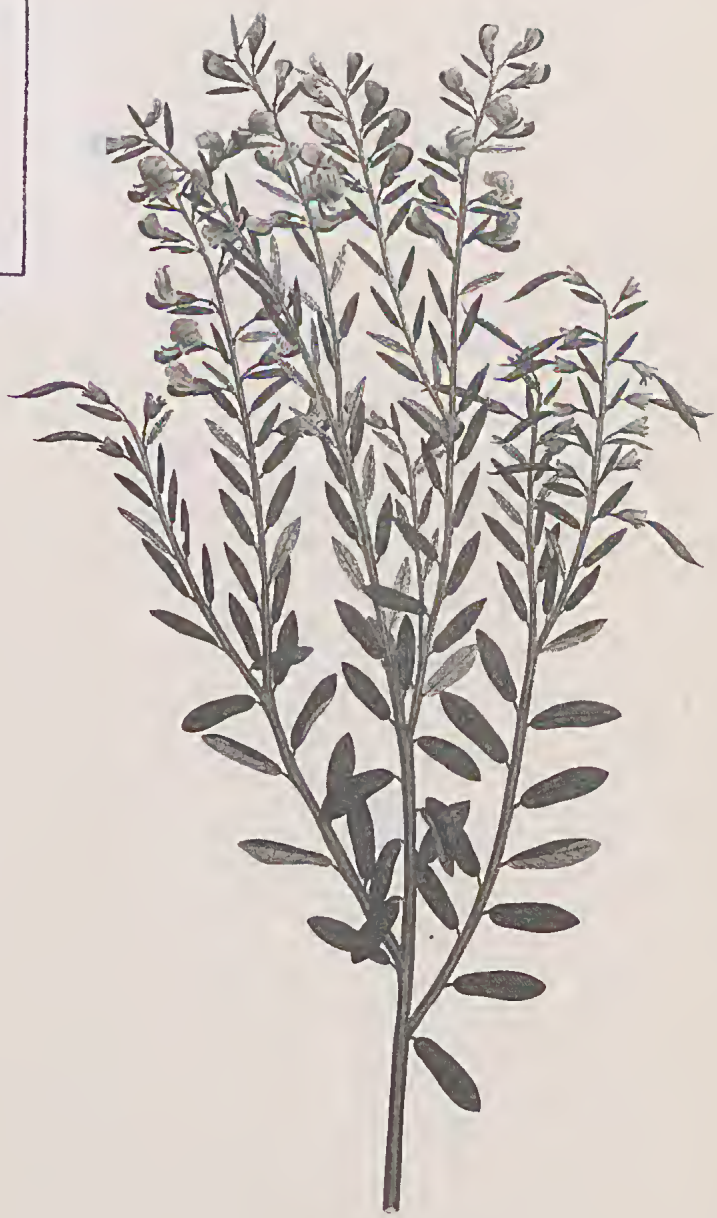

***Bossiaea heterophylla* Vent.** (1800) [*Description des Plantes Nouvelles et peu connues, cultivees dans le Jardin de J.M. Cels* 1: 7, t7]
Source: State Botanical Collection
Illustration: Banks, J. and Solander, D. (1900) *Illustrations of the Botany of Captain Cooks Voyage* 1, pl 51

Many Australian plants became available through the British and French nursery trade from the early 1770s. *Bossiaea heterophylla* was introduced to the garden of JM Cels in Paris around 1792. However, the species was not officially described until 1800.

Muelleria publishes research papers on Southern Hemisphere plant, algal and fungal systematics, particularly relating to Australia. Acceptable submissions include: taxonomic revisions; phylogenetic and biogeographical studies; short papers describing new taxa, documenting nationally significant new records, or resolving nomenclatural matters; historical analyses relevant to systematics; and any research contributing to our knowledge of plant, algal or fungal diversity. Special issues or reviews will also be considered after discussion with the Editor.

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A revision of *Alphitonia* (Rhamnaceae) for Australia

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Introduction

Alphitonia Endl. is a genus comprising around 15 species, and belonging to the family Rhamnaceae. It was described by Endlicher (1840), with the description based on *Colubrina excelsa* Fenzl. (=*A. excelsa* (Fenzl) Benth.).

Within the family Rhamnaceae, *Alphitonia* is characterised by its leaves with a bright green upper surface and a strikingly white (or sometimes greyish-white or yellowish) lower surface; tardily dehiscent fruits, usually with a powdery mesocarp; seeds persistent on the torus after the endocarp has shed, and enveloped by a membranous aril. Most species are fast-growing pioneers with pagoda-type branching, filling canopy gaps in evergreen notophyll or mesophyll rainforest.

Bentham (1863) recognised only *A. excelsa* for Australia, and considered that the genus was 'probably limited to a single species, ranging from Australia to the Pacific islands'. The genus was revised by Braid (1925), who enumerated 13 species. He recognised five species as occurring in Australia (*A. excelsa, A. petriei* Braid & C.T.White, *A. obtusifolia* Braid, *A. whitei* Braid and *A. moluccana* Braid). In this paper, five species are also recognised (*A. excelsa, A. petriei, A. pomaderroides* (Fenzl) A.R.Bean, *A. whitei* and *A. oblata sp. nov.*). No species is presently thought to be rare or threatened.

Alphitonia franguloides A.Gray, *A. incana* (Roxb.) Kurz, *A. moluccana* and *A. philippinensis* Braid are here excluded from the Australian flora. The Malesian species *A. incana* is lectotypified, and its identity discussed, particularly with respect to *A. oblata*.

Materials and methods

This revision is based upon a morphological study of herbarium material from BR, BRI, MEL and QRS, as well as images from K, and field observations in Queensland, Northern Territory and New South Wales. Indumentum characters were assessed on dried herbarium specimens, with all stem indumentum measurements made at a point 10 cm below the growing point (or the insertion point of the most terminal leaf).

Abstract

The taxonomy of the genus *Alphitonia* Endl. is reassessed for Australia, and five species are recognised. *Alphitonia oblata* A.R.Bean *sp. nov.* is described, illustrated and diagnosed against related taxa. Descriptions, distribution maps and miscellaneous notes are provided for all species. Lectotypes are selected for *A. excelsa* (Fenzl) Benth., *A. petriei* Braid & C.T.White, and *A. whitei* Braid. The identity of *A. incana* (Roxb.) Kurz is discussed and the name lectotypified. The names *A. franguloides* A.Gray, *A. incana, A. moluccana* Braid and *A. philippinensis* Braid are excluded from the Australian flora.

Keywords: Rhamnaceae, rainforest, taxonomy, keys, lectotypes.

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'Adult' material is that which bears flowers or fruits, while material accepted here as 'juvenile' is sterile and labelled as belonging to a young plant. Leaf and fruit measurements are based on dried material, while floral measurements are based on material preserved in spirit or reconstituted. Only authors of validly published names are reported in this paper.

Results and discussion

Generic relationships

Richardson *et al.* (2000) published a classification of the Rhamnaceae based on DNA sequences. Medan and Schirarend (2004) provided a taxonomic summary of the family, and listed 52 genera and 11 tribes, utilising the classification of Richardson *et al.* (2000). *Alphitonia* was one of seven genera not assigned to a Tribe, along with five other genera that occur in Australia.

Rye (1996) established the genus *Granitites*, and stated that it is most closely related to *Alphitonia*. Although *Granitites intangendus* (F.Muell.) Rye (the only species) is a small spinescent shrub endemic to south-west Western Australia, its close relationship with *Alphitonia* has been confirmed by Fay *et al.* (2001) using DNA sequence data. Both genera have a mealy mesocarp, anther appendages, similar disc shape and arillate seeds.

Alphitonia is also closely related to *Emmenosperma* F.Muell. Both genera are unarmed, with entire leaves and seeds persisting on the torus after the rest of the fruit has fallen. *Emmenosperma* differs by the yellow to orange fruits that lack a powdery mesocarp, the flowers with a much thinner nectary disc that does not fill the hypanthium, and the seeds without an enveloping aril.

Discussion of morphological characters

The leaf size and shape provide some diagnostic features in *Alphitonia*, but must be used cautiously, as environmental factors may greatly influence them. The colour of the indumentum on the lower surface, excluding the veins, is usually white but can be yellowish (*A. pomaderroides*) or greyish-white (*A. whitei*). Leaf venation is of the same pattern throughout the genus. Stipule size is diagnostic for some species. Trichomes are always simple, but there are differences between species in the density, colour, length and straightness of the hairs. The flowers are remarkably constant within the genus; only the ornamentation of the disc and the amount and density of indument on the disc are of taxonomic value.

Fruiting characters appear to offer the greatest potential for taxonomic discrimination. The size, and more particularly the shape, of the mature fruits is consistent for a species. For instance, the fruits of *A. excelsa* are always globose, while the fruits of *A. petriei* are always conspicuously oblate. Unfortunately, these characters are difficult to assess from herbarium material. Very soon after maturity, the mesocarp and exocarp of *Alphitonia* fruits disintegrate, so that the former shape of the fruits is lost. Conversely, when the fruits on a herbarium specimen are intact, one must be suspicious that they have not reached their mature size and shape.

The size of the endocarpids (and their apicula) and the length of the seeds are also taxonomically useful, and these *can* be readily measured from herbarium specimens. The endocarp in *Alphitonia* is a hard, bony or woody persistent layer that protects the seeds during their development. Partitions in the endocarp can be readily seen in an immature fruit and, at maturity, they become separate entities, termed endocarpids. The number of endocarpids corresponds to the number of styles in the flower, and each encloses a single seed. The endocarpid opens widely along its ventral surface, and it sometimes splits partially along the dorsal surface. It is not in contact with the seed, and when it is shed from the fruit, the seed is often still attached to the torus. The endocarpid frequently has a sharp apiculum on its distal end. In Australian species, the apiculum is not visible while the fruit is intact, being obscured by the mesocarp and epicarp tissue.

The other very useful and species-specific character is the branching structure of the tree. In many species (e.g. *A. zizyphoides* A.Gray, *A. petriei, A. oblata*), trees exhibit a pagoda-type branching habit, with layers of large horizontal branches, and conforming to Roux's model of tree architecture (Hallé *et al.* 1978). This model is characterised by a monopodial orthotropic trunk, branches that are plagiotropic and inserted continuously, and spiral leaf arrangement on the trunk but distichous on the branches. Other species (*e.g. A. excelsa, A. pomaderroides, A. whitei*) have ascending

primary and secondary branches and a more haphazard arrangement of smaller branches, resulting in a more evenly distributed canopy.

The branching structure can be assessed only by field examination, and collectors of herbarium specimens rarely note the canopy structure of the tree. It cannot be inferred by the arrangement of the leaves on the ultimate branchlets (spiral or distichous). With the exception of *A. whitei*, the branchlets of all Australian species bear leaves that are consistently distichous.

Taxonomy

Alphitonia Reissek ex Endl., *Gen. Pl. [Endlicher]* 1098 (1840). Type: *A. excelsa* (Fenzl) Benth.

Trees, or rarely shrubs, evergreen. *Spines* absent. *Branches* (in most species) horizontal, in layers ('pagoda-type' branching). *Indumentum* of simple, unbranched trichomes, straight, flexuose, tortuous or crisped; glands absent. *Leaves* simple, alternate, petiolate, distichous on smaller branches (except sometimes *A. whitei*), penninerved, intramarginal veins absent, margins entire, straight or undulate; translucent dots absent; upper surface green, glabrous or glabrescent; lower surface with dense short tomentum, often white; domatia absent; stipules two per leaf, free from each other, entire, caducous. *Inflorescences* dichasially or trichasially cymose, arranged into axillary racemes; flowers bisexual, protandrous, 5-merous; *calyx* 5-lobed, spreading, adaxially keeled; petals 5, cymbiform, caducous; *stamens* 5, each enclosed within a petal; anthers broadly sagittate with an appendage, versatile, basifixed, dehiscent by longitudinal slits; *nectary disc* thick, fleshy, filling the floral tube; *style* solitary, 2–3(–4)-fid, rudimentary before anthesis, elongating after anthesis; *ovary* partly inferior, 2–3(–4)-locular. *Fruits* drupaceous, tardily dehiscent, the lower portion united with the calyx tube; epicarp thin, black, shiny, with ring-scar marking position of fallen sepals; mesocarp (when present) spongy to powdery, reddish; endocarpids hard, woody, often apiculate, dehiscing along the ventral suture and partly down the dorsal suture, each enclosing a single seed. *Seeds* often persistent on torus after remainder of fruit has fallen away, grey, with glossy hard testa, enclosed by membranous reddish-brown aril.

Distribution

Alphitonia is a western Pacific genus. Natural stands of *Alphitonia* occur as far north as Hainan (southern China), west to Borneo, east to Tahiti, Hawaii and the Marquesas Islands, and to southern coastal New South Wales in the south. The map by Balgooy (1966) provides an accurate portrayal of the generic distribution, except for an alleged occurrence of the genus in the Pilbara region of Western Australia. The greatest species diversity is in New Guinea, Australia and New Caledonia.

1. *Alphitonia excelsa* (Fenzl) Benth., *Fl. Austral.* 1: 414 (1863)

Colubrina excelsa Fenzl in Endl., *Enum. Pl. [Endlicher]* 20 (1837); *Ceanothus excelsus* (Fenzl) Steud., *Nomencl. Bot. [Steudel], ed. 2*, 2: 313 (1841).

Ceanothus excelsus A.Cunn., *nom. nud.*

Type: [Queensland] Moreton Bay, undated, *A. Cunningham* (lectotype W, here designated; ?isolectotype BRI).

Alphitonia excelsa var. *acutifolia* Braid, *Bull. Misc. Inform. Kew* 177 (1925). Type: Queensland. MORETON: Ipswich, undated, *T.F. Hall 9* (holotype K, image!; isotype BRI).

Alphitonia sp. (Selwyn Ranges L.P.Conroy 3) in Bean (2002), Bean (2007).

Alphitonia sp. (Little Crystal Creek A.R.Bean 5237) in Bean (2002), Bean (2007).

Illustrations: T.D. Stanley & E.M. Ross, *Flora of south-eastern Queensland* 2: 49, fig. J1, J2 (1986); Logan River Branch SGAP, *Mangroves to Mountains* 1: 57 (2002); G.J. Harden *et al.*, *Rainforest Trees and shrubs, A field guide to their identification* 152 (2006); R. Melzer and J. Plumb, *Plants of Capricornia* 284 (2007).

Tree 4–20 m high. Bark persistent, tessellated and dark at base of large trees; otherwise smooth, dappled white and grey. *Primary branches* ascending, with secondary and tertiary branches on different planes. *Branchlets* not prominently ridged near growing point; stipules 3–14 mm long, linear to narrowly-triangular. Juvenile stem *indumentum* in some forms dense, rusty, straight to flexuose, patent, to 0.6 mm high; in other forms with moderately dense white crisped hairs to 0.1 mm high, and scattered brown straight

Key to flowering specimens of Australian *Alphitonia*

1 Young branchlets prominently furrowed, hairs dark brown; stipules 1–2(–4) mm long.....*4. A. petriei*

1: Young branchlets terete or angular, but not furrowed, hairs pale to mid-brown; stipules 3–14 mm long.....2

2 Leaves broadest at or above midpoint, dirty greyish-white on underside; pedicels 0.8–2 mm long at anthesis.....*3. A. whitei*

2: Leaves broadest below midpoint, white or yellowish on underside (except veins); pedicels 1.7–4 mm long at anthesis.....3

3 Leaf bases obtuse (sometimes slightly cordate); disc with 10 prominent radial furrows; all flowers with 3-fid styles.....*5. A. oblata*

3: Leaf bases cuneate (sometimes obtuse); disc flat or undulate, without prominent furrows; the majority of flowers with 2-fid styles.....4

4 Leaves 1.4–2.4 times longer than wide, yellowish on underside, apex mostly obtuse; styles 1.1–1.7 mm long after elongation.....*2. A. pomaderroides*

4: Leaves 2.2–4.6 times longer than wide, white on underside, apex mostly acute; styles 0.8–1.2 mm long after elongation.....*1. A. excelsa*

Key to fruiting specimens of Australian *Alphitonia*

1 Fruits without powdery mesocarp; apiculum on distal end of endocarpid 0–0.5 mm long.....*3. A. whitei*

1: Fruits with powdery mesocarp; apiculum on distal end of endocarpid 0.5–2 mm long.....2

2 Fruits oblate, considerably broader than long, 13–15 mm diameter, consistently 3-locular.....3

2: Fruits globose, 7–12 mm diameter; majority of fruits 2-locular, but with some 3-locular ones present.....4

3 Seeds (aril removed) 2.9–3.4 mm long; endocarpids (excl. apiculum) 4.5–5.5 mm long; new growth dark brown.....*4. A. petriei*

3: Seeds (aril removed) 4.1–5.0 mm long; endocarpids (excl. apiculum) 6.5–8 mm long; new growth pale to mid-brown.....*5. A. oblata*

4 Mature fruits 7–10 mm long; seeds 4–5.7 mm long; leaves 2.2–4.6 times longer than wide, white underneath, apex mostly acute.....*1. A. excelsa*

4: Mature fruits 9.5–11 mm long; seeds 5.4–6.3 mm long; leaves 1.4–2.4 times longer than wide, yellowish underneath, apex mostly obtuse.....*2. A. pomaderroides*

Field key to Australian *Alphitonia*

1 Canopy widely spreading, comprising numerous layers of horizontal branches.....2

1: Canopy not widely spreading, branches ascending and not in distinct layers.....3

2 Leaf base frequently obtuse; trees flowering in autumn (March–May); young branchlets with pale to mid-brown tomentum.....*5. A. oblata*

2: Leaf base usually broadly cuneate; trees flowering in spring (August–November); young branchlets with dark brown tomentum.....*4. A. petriei*

3 Tree of climax rainforest; leaves broadest at or above the midpoint.....*3. A. whitei*

3: Shrubs or trees of open forest and woodland, sometimes rainforest edges; leaves broadest below midpoint.....4

4 Shrub or tree to 7 metres; leaves 1.4–2.4 times longer than wide, yellowish-white underneath, apex mostly obtuse; inhabiting flats or lower hillslopes.....*2. A. pomaderroides*

4: Tree 4–20 metres high; leaves 2.2–4.6 times longer than wide, white underneath, apex mostly acute; inhabiting flats, riverbanks, hills and ridges.....*1. A. excelsa*

or flexuose hairs to 0.4 mm high. Juvenile *leaves* variable, sometimes broadly elliptical, lower surface with white hairs throughout, apex obtuse, petioles very short; sometimes narrowly ovate, lower surface with abundant rusty hairs on veins, apex acute to acuminate. Adult stem *indumentum* sparse to dense, grey to creamy-white, crisped hairs c. 0.1 mm high, and scattered erect flexuose hairs to 0.3 mm high. *Leaves* 2-ranked, elliptic, narrowly-elliptic, narrowly-ovate or lanceolate, 6.1–18.5 × 1.8–6 cm (L/B ratio 2.2–4.6), apex acute or obtuse, sometimes mucronate; base cuneate, occasionally obtuse, symmetrical or not; newly expanded leaves mid-brown to pale brown; petioles 0.8–2.3 cm long, hair cover 0.1–0.5 mm high. Upper leaf surface dark green, glossy, glabrous except when very young, when numerous white or pale brown tortuous hairs cover the surface; lower leaf surface with abundant tiny white crisped hairs in the areoles, obscuring the lamina, and scattered pale brown tortuous hairs to 0.6 mm long along the veins and veinlets. *Cymes* occurring in up to 7 leaf axils per branchlet, each 3.5–9 cm long when flowering, none truly terminal. *Pedicels* 1.7–4 mm long at anthesis. *Bracts* ovate, c. 0.5–1.5 × 0.5–1.2 mm. *Flowers* 4–6 mm across; sepals deltate, 1.4–1.7 mm long, 1.2–1.7 mm wide at base, glabrous internally; petals white, 1.2–1.7 mm long; filaments 1.0–1.4 mm long; anthers 0.2–0.4 mm long, tail 0.05–0.1 mm long. *Disc* pentagonal to circular, grey, not papillose, surface flat or undulate, radial furrows absent or present (10); densely or sparsely hairy (erect brown or white hairs close to style) or glabrous. *Style* 2(–3)-fid, 0.8–1.2 mm long after elongation. Fruiting pedicels 1.5–5 mm long, 0.7–0.9 mm diameter. Mature *fruits* black and somewhat glossy at maturity or occasionally with a glaucous bloom, glabrous, globose, 2(–3)-locular, 7–10 mm long, 7–11 mm diameter; calyx scar close to pedicel end, or sometimes almost halfway along; powdery mesocarp abundant. Endocarpids (when opened) 6–8.2 mm long (excluding apiculum), 6–6.5 mm wide, radius 3–5 mm; apiculum 0.5–1 mm long, terminal. Aril maroon; *seeds* grey, 4–5.7 × 2.9–4 × 1.8–2.4 mm. *Soap Tree, Red Ash.*

Distributian and habitat: *Alphitonia excelsa* is a very widespread and common species, occurring in eastern New South Wales, throughout much of Queensland, in the northern one-third of the Northern Territory and in the Kimberley region of Western Australia (Fig. 1). It also occurs in southern lowland New Guinea. It grows over a wide range of climatic conditions. In more coastal areas, it grows on a range of well-drained sandy or loamy soils, usually in eucalypt forest, but sometimes on the edges of notophyll rainforest. In drier inland areas, it is confined to low-lying areas with very sandy soils or small sheltered gorges.

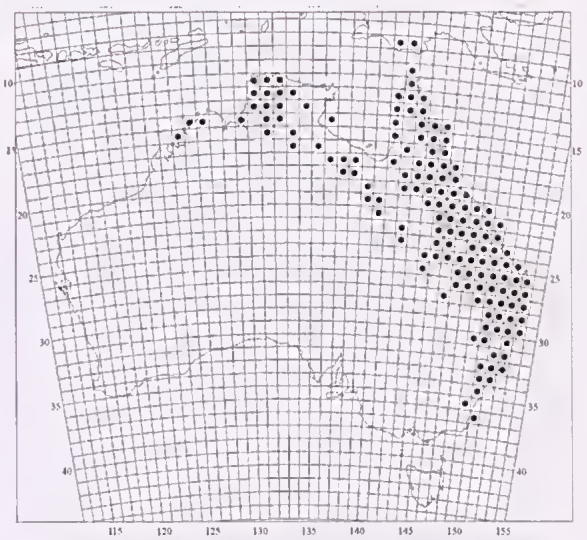

Figure 1. Distribution of *Alphitonia excelsa* in 1° grids.

Phenalagy: The great majority of flowering records are from January to April, but there are some for December and May, and an occasional record from other months of the year. Ripe fruits and/or persisting seeds are found from June to December.

Typification: The type of *Colubrina excelsa* at W was annotated as '(LECTO-) HOLOTYPE' by Johnston in 1968, and as 'HOLOTYPE' by Thiele in 2001. Since there is a specimen at BRI that may be a part of the same gathering as the W specimen, and because Cunningham's specimens are so widely distributed, it seemed wise to choose the W specimen as the lectotype, to avoid any ambiguity in the future.

Nates: *Alphitonia excelsa* is a very polymorphic species, but despite its huge range of variability, it has not proved possible to split any species from it or distinguish subspecies within it. Specimens at BRI included under the preliminary taxon names 'sp. Selwyn Ranges' and 'sp. Little Crystal Creek' are distinctive when viewed in isolation, but there is a gradual transition between these specimens and

others that are nearer to the typical form of the species. The Cape York Peninsula form of *A. excelsa* is very similar to specimens of *A. philippinensis* from the Philippines, but the latter has smaller endocarpids with a long apiculum, and conspicuous radial furrows on the disc. Fruits of *A. excelsa* are consistently globose. There is a predominance of flowers with 2-locular ovaries and 2-fid styles, but some flowers with 3-fid styles can usually be found on any given plant or flowering specimen.

Alphitonia excelsa, in contrast to some other Australian species, has ascending primary branches and more-or-less evenly distributed leaf canopy. This canopy type is consistent even for those forms that occur in rainforest environments.

The relationship between *A. excelsa* and *A. oblata* in Northern Territory and Western Australia requires further study. In 1994, K. Thiele determined all Kimberley specimens of *Alphitonia* at BRI as *A. incana*, while Wheeler (1992) included only *A. excelsa* for this region. According to Booth *et al.* (2001), *A. excelsa* and *A. 'incana'* (i.e. *A. oblata*) intergrade in the Darwin area, and this may account for differing names applied in the Northern Territory and Kimberley region of Western Australia.

Alphitonia excelsa is the food plant for the larvae of the Small Green-banded blue butterfly (*Psychonotis caelius*). The timber has a density of 770 kg/m^3 and has been used for fencing and ornamental panelling. It is pale when cut, but upon exposure turns to a bright red (Fairbairn 1999).

Selected specimens examined: **WESTERN AUSTRALIA.** 1 km E of Mitchell Falls, Mitchell Plateau, 30.v.1992, *D. Holford Q1431* (BRI, DNA, PERTH); Morgan River, near old 'Theda' homestead, 24.vii.1977, *I.R. Telford 6102 & G. Butler* (BRI, CANB). **NORTHERN TERRITORY.** Elcho Island, 2.vii.1975, *J.R. Moconochie 2094* (BRI, CANB, K, L); Waldunga road/Old Plains track junction, Murgenella, 10.vii.1984, *G. Wightmon 2004* (BRI, CANB, DNA); 1 km SE of Angurugu, Groote Eylandt, 7.iii.1988, *J. Russell-Smith 5136 & D. Lucos* (BRI, DNA). **QUEENSLAND.** BURKE: c. 5 km S of Lake Moondarra, just 2.5 km off the Mt Isa to Lake Moondarra Road, 23.viii.2001, *D.T. Kelmon DTK16 & J.E. Kelman* (BRI). COOK: Olive River, 72.9 km NNW of Lockhart River community, 26.iv.1994, *D.G. Fell DGF4235* (BRI, DNA, NSW). NORTH KENNEDY: 40 Mile Scrub N.P., 1.6 km N of Mt Surprise road junction, 11.iii.1987, *J.R. Clarkson 6878 & W.J. McDonald* (BRI, L, QRS, PERTH). SOUTH KENNEDY: Keswick Island, Basil Bay, 6.ix.1996, *G.N. Botionoff 9609172 et ol.* (AD, BRI, CANB, DNA, MEL, NSW). MITCHELL: 1.5 km NW of Betanga on Capricorn Hwy E of Jericho, 31.iii.1992, *E.J. Thompson JER5 & B.K. Simon* (AD, BRI, DNA, PERTH). LEICHHARDT: c. 20 miles [32 km] ESE of Rolleston, 30.viii.1961, *M. Lazorides & R. Story 110* (BRI, CANβ). PORT CURTIS: Shoalwater Bay Military Reserve, 2 km W of Sabina Point, 13.vii.1977, *J.R. Clarkson 1088 & T.D. Stanley* (BRI). BURNETT: northern slopes of Mulgildie Plateau, SSE of Monto, 11.ii.1996, *A.R. Beon 9744* (BRI, MEL). WIDE BAY: Waddy Point, S of Orchid Village, Fraser Island, 14.i.1973, *T. Whoite 3504 & J. Whoite* (BRI). MARANOA: c. 89 km W of Condamine toward Surat, near Back Creek crossing, 13.x.1983, *E.M. Conning 5952 & B. Rimes* (BRI, NSW). DARLING DOWNS: Leichhardt Hwy, c. 23 km N of Miles, 17.v.1988, *P.C. Jobson 266* (BRI, MEL). MORETON: Mt Mellum, Glasshouse Mountains, 10.xii.1987, *D.E. Albrecht 3457* (BRI, MEL). **NEW SOUTH WALES.** Pike's Gap, Denman to Sandy Hollow road, 11.ix.1948, *E.F. Constable NSW 121556* (BRI, NSW); Yellow Rock Creek road, c. 4 miles [6 km] SW of Albion Park, 28.ii.1967, *M. Evons 2585* (AD, BRI, CANB, NSW); 'Lowry', above Namoi River, Namoi River road, 13.i.1992, *J.R. Hosking 467* (BRI, NSW).

2. *Alphitonia pomaderroides* (Fenzl) A.R.Bean, *Austrobaileya* 7: 377 (2006)

Ziziphus pomaderroides Fenzl in Endl., *Enum. Pl. [Endlicher]* 20 (1837).

Type: [Queensland] Cape Van Diemen, December 1802, *F. Bauer s.n.* (holotype W, photo at BRI).

Alphitonia obtusifolia Braid, *Bull. Misc. Inform. Kew* 182 (1925).

Caenothoides obtusifolia R.Br., *nom. nud.*

Type: [Queensland] 'Carpentaria', undated [17–27.xi.1802], *R. Brown* [Bennett No. 5364] (holotype K, image!; isotype BM, BRI [AQ 317590]).

Alphitonia obtusifolia var. *tenuis* Braid, *Bull. Misc. Inform. Kew* 183 (1925). *Type:* [Queensland] 'North Coast', [xi.1802], *R. Brown* (syntype K, image!).

Shrub or tree to 7 m high. Bark persistent, tessellated and dark at base of large trees; otherwise smooth, dappled white and grey. Primary *branches* ascending, with secondary and tertiary branches on various planes. *Branchlets* not noticeably ridged near growing point; stipules 3–6 mm long. Juvenile stem *indumentum* and juvenile leaves unknown. Adult stem *indumentum* dense, with abundant pale brown to creamy-white crisped hairs c. 0.1 mm high, and infrequent straight or curved patent hairs to 0.3 mm high. Adult *leaves* 2-ranked, ovate to elliptical, 5.6–15.5 × 3.2–8.0 cm (L/B ratio 1.4–2.4); apex obtuse, acute or retuse; base obtuse to cuneate, symmetrical; newly expanding leaves dark

brown; petioles 0.7–2.1 cm long, hairs to 0.4 mm long. Upper leaf surface dull green, with persisting flexuose hairs to 0.4 mm long, glabrescent; lower leaf surface white or yellowish, with abundant tiny white crisped hairs in the areoles, obscuring the lamina, and brown flexuose to straight hairs to 0.4 mm long along the veins and veinlets; midrib and secondary veins sparsely to densely hairy, brown. *Cymes* occurring in up to 5 leaf axils per branchlet, each 2–6 cm long, none truly terminal (terminal only by abortion of the terminal vegetative shoot). Pedicels 2.5–3.5 mm long at anthesis. *Bracts* and bracteoles broadly ovate, 0.7–1 × 0.4–0.8 mm. *Flowers* 5.5–7.0 mm across; sepals deltate, 1.7–2.3 mm long, 1.7–2.0 mm wide at base, glabrous internally; petals white, 1.5–1.8 mm long; filaments 1.2–1.6 mm long; anthers 0.35–0.5 mm long, tail 0.1–0.15 mm long. *Disc* circular to pentagonal, grey, not papillose, surface undulating or flat, radial furrows absent; glabrous or with a few hairs at the base of the style. *Style* 2-fid (rarely 3-fid), 1.1–1.7 mm long after elongation. Fruiting pedicels 2.5–5.5 mm long, c. 0.8 mm diameter at midpoint. *Fruits* black at maturity, somewhat glossy, glabrous, globose, 2(–3)-locular, 9.5–11 mm long, 10–12 mm diameter, calyx scar close to pedicel end; powdery mesocarp abundant. Endocarpids 7–8.5 mm long (excluding apiculum), 6.5–9 mm wide, radius 5–6 mm, apiculum 0.5–1 mm long, terminal or subterminal. Aril orange to reddish-brown; *seeds* grey, 5.4–6.3 × 3.7–4.5 × 2–2.3 mm.

Distribution and habitat: *Alphitonia pomaderroides* is common in north-eastern Australia, from Mareeba (Qld) in the east to Roper River (Northern Territory) in the west. It grows throughout most of Cape York Peninsula and extends south to near Croydon and Pentland (Fig. 2). It is an understorey species in eucalypt or melaleuca-dominated woodlands, where the surface soil is sandy to sandy-loam.

Phenology: Flowers are recorded between November and May. Ripe fruits and/or persisting seeds are found from between May and September.

Typification: The types of *A. obtusifolia* and *A. obtusifolia* var. *tenuis*, while collected around the same time, are apparently not from the same gathering, as the leaf shape on these specimens is somewhat different.

Notes: Although there are no definitive characters

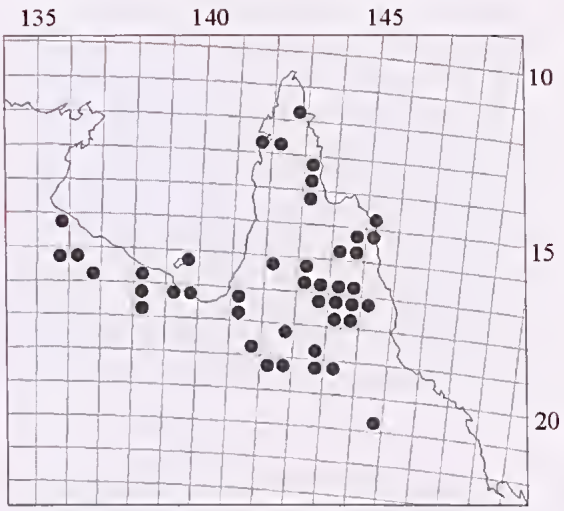

Figure 2. Distribution of *Alphitonia pomaderroides* in 0.5° grids.

to separate *A. pomaderroides* and *A. excelsa* in the herbarium, they are rarely confused in the field. *A. pomaderroides* differs by its rather shrubby habit, the relatively broader leaves (L/B ratio of 1.4–2.4), and leaf undersides with a yellowish tint, and the mostly larger endocarpids and seeds. It tends to inhabit sandy flats or lower slopes in undulating terrain, in areas that have poor sub-surface drainage during the wet season. *A. excelsa* is a larger tree with relatively narrow leaves with pure white undersides. Where the two species occur in the same region, *A. excelsa* will be found on well-drained stony ridges or on riverbanks. No hybridisation or intergradation between these species has been noted in the field or recorded on herbarium labels.

Selected specimens examined: **NORTHERN TERRITORY.** Mt Young, Nathan River station, 20.i.1989, *J. Russell-Smith 6728 & D. Lucas* (BRI, DNA); Caranbirini Waterhole, 45 km W of Borroloola, 5.ix.1981, *T. Whaite 3974 & J. Whaite* (BRI, NSW); 7 km W of Borroloola, 27.vi.1977, *J. Must 1542* (BRI, CANB, DNA, K, L). **QUEENSLAND.** COOK: Cholmondelay Ck crossing, on Telegraph Line road, 11 km SW of Heathlands, 6.iii.1992, *R.W. Johnson 5137* (BRI, DNA, MEL, NSW); 23.5 km ENE of Weipa Mission, 9.xii.1974, *R.L. Specht W188 & R.B. Salt* (BRI); 8.2 km from Kennedy River on the Fairview to Kimba road, 20.iv.1980, *J.R. Clarkson 3185* (K, MO, QRS); near granite gorge off Chewko road, near Mareeba, 10.iv.1990, *H. van der Werff 11509* (MO, QRS); Pannikan Springs area, 29 km west of Mungana, 26.i.1993, *A.R. Bean 5624 & P.I. Forster* (BRI, K, MEL); Chillagoe, i.1918, *N. Michael 303* (BRI); 6 km by road W of Petford, 22.vi.2006, *K.R.*

McDonald KRM5312 (BRI); 20 km NW of Mt Garnet, on road to Lappa, 19.i.1993, *A.R. Bean 5484 & P.I. Forster* (BRI, DNA, MEL). BURKE: Sweers Island, South Wellesley Islands, southern Gulf of Carpentaria, 15.xi.2002, *M.B. Thomas SW155 & L. Pedley* (BRI, DNA, UPNG); 0.4 km SSE of Hell's Gate roadhouse, 9.vi.2006, *E.J. Thompson WES769* (BRI, DNA); 33.5 km NNE of Normanton on road to Lotus Vale Station, 16.vii.1974, *P. Ollerenshaw 1460 & D. Kratzing* (BRI, CANB); 15 km NE of Claraville H5, on road to Croydon, 9.viii.1987, *C. Dalliston HC383* (BRI); eastern side of 'Pioneer', about 150 km NNE of Julia Creek, 8.iv.2001, *D.C. Johnson & D.T. Kelman s.n.* (BRI [AQ 752837]). SOUTH KENNEDY: c. 57 km SE of Pentland, 29.vi.1998, *E.J. Thompson CHA425 & G.P. Turpin* (BRI).

3. *Alphitonia whitei* Braid, *Bull. Misc. Inform. Kew* 181 (1925)

Type citation: 'Near Barron River, *Bailey* (24)*; Innisfail, *Ladbrook* 26, *Michael* 400; Jordan Creek, *Mocatta* 23*'.
Type: Queensland. Jordan Creek, Innisfail district, xi.1912, *H.W. Mocatta 23* (**lectotype** K, here designated; isolectotype BRI [AQ 317596]).
[*A. excelsa* var. *franguloides* auct. non (A.Gray) F.M.Bailey: *Compr. Cat. Queensland Pl.* 837 (1913)]
Illustration: K.A. Williams, *Native Plants of Queensland* 4: 47 (1999).

Tree 18 m high. Bark smooth, dappled white and grey. Crown ascending, with secondary and tertiary *branches* on various planes. Branchlets not noticeably ridged near growing point; stipules 5.5–12 mm long. Juvenile stem *indumentum* absent or sparse, hairs grey to brown, all crisped, to 0.1 mm high. Juvenile *leaves* elliptic, 18–27 × 7–10 cm. Adult stem *indumentum* absent or sparse, hairs grey, all crisped, to 0.1 mm high. Adult *leaves* spirally arranged or distichous, obovate or broadly elliptic, 13–23 × 5.3–9.7 cm (L/B ratio 2.2–3.9), apex acute, acuminate or mucronate; base cuneate, symmetrical; petioles 1.5–2.5 cm long, hairs <0.1 mm long. Upper leaf surface dark green, glossy, glabrous except when very young, when numerous brown tortuous hairs cover the surface; lower leaf surface usually a dirty-grey colour, sometimes white, with abundant tiny white cobwebby hairs in the areoles, often completely obscuring the lamina, tortuous hairs absent or very infrequent, to 0.5 mm long; midrib and secondary veins glabrescent, brown. *Cymes* occurring in up to 5 leaf axils per branchlet, each 6–21 cm long, often appearing terminal due to abortion of the uppermost leaves; rachises, peduncles and pedicels consistently rusty-brown in colour. Pedicels 0.8–2 mm long at anthesis. Bracts ovate, concave, 3.5–4 × 2–2.2 mm; bracteoles linear, 1.5–2 × 0.3 mm. *Flowers* 3.5–4.8 mm across; sepals deltate, 1.3–1.7 mm long, 1.3–1.6 mm wide at base, glabrous internally; petals white, 1.0–1.4 mm long; filaments 0.8–1.0 mm long; anthers 0.25–0.3 mm long, tail c. 0.05 mm long. *Disc* pentagonal, grey, not papillose, surface flat or undulate, radial furrows absent; glabrous, except for inner one-third to one-half where there is a dense cover of pale brown flexuose trichomes close to style. *Style* 2-fid, 0.7–1.0 mm long after elongation, glabrous throughout, fused for half of length. Fruiting pedicels 1.3–4 mm long, 1.0–1.4 mm diameter. *Fruits* black at maturity, somewhat glossy, glabrous, slightly longer than wide, 2-locular, 7–9 mm long, 6–8 mm diameter, calyx scar 30–50% of distance from pedicel end; mesocarp absent. Endocarpids (when opened) 6.5–8 mm long (excluding apiculum), 6.5–8 mm wide, radius 3.3–4 mm, apiculum 0–0.5 mm long, terminal. Aril maroon; *seed* dark grey, 4.2–5.3 × 3.8–4.9 × 1.6–1.8 mm.

Distribution and habitat: *Alphitonia whitei* is endemic to Queensland where it extends from near Townsville to Bloomfield River (south of Cooktown), with a disjunct occurrence in the MacIlwraith Range east of Coen (Fig. 3). It inhabits primary or climax rainforest on a variety of soils with a vast range of other tree species. It extends from sea level to around 1200 metres.

Phenology: *Alphitonia whitei* flowers from September to November, and mature fruits are recorded from December to March.

Typification: In his *Alphitonia* paper, Braid (1925) indicated type specimens in the protologue by means of an asterisk. For *A. whitei*, there are two specimens annotated by an asterisk (*Mocatta 23* and *Bailey 24*). The Mocatta specimen at K bears adult leaves and flowers, and is chosen as the lectotype as it better fits the protologue. The Bailey specimen (sheets at BRI and K) bears adult leaves, fruits and seeds. Braid in the protologue stated 'Fructus non visus'. The '23' associated with the lectotype is probably not a collection number assigned by the collector. It could have been assigned by C.T. White when preparing specimens to be sent to Braid.

Notes: Unlike other Australian *Alphitonia* spp., *A. whitei* is an inhabitant of climax rainforest, and shows

no inclination to dominate regrowth. It does not seem closely related to any other Australian species, and it may be closest to *A. macrocarpa* Mansf. from Papuasia; *A. whitei* and that species are both remarkable for their fruits with short pedicels and a total lack of mesocarp. The lower leaf surface of both species has indumentum so thick and appressed that no individual hairs are discernable, and to the naked eye the greyish-white colouration could easily be interpreted as due to surface wax rather than hairs.

Selected specimens examined: **QUEENSLAND.** COOK: Leo Creek Mine area, T.R. 14, MacIlwraith Range, 20.vi.1995, *P.I. Forster PIF16876* (BRI); 1 mile [1.6 km] NW of Stuckies Gap, Bloomfield River area, 17.v.1969, *L.J. Webb & J.G. Tracey 8442* (BRI); SF144, Mt Windsor Tableland, 3.5 km past barracks, 31.x.1999, *P.I. Forster PIF25134* (A, BRI, K, L, MEL, QRS); Daintree River, 13.xii.1929, *S.F. Kojewski 1477* (BRI); Rex Range, NE of Julatten, 28.i.1993, *A.R. Bean 5674 & P.I. Forster* (BRI, L); O'Donoghue's cane farm, Saltwater Creek, Mossman, 12.x.1982, *K.A. Willioms 82163* (BRI); Copper Lode Dam, Whitfield Range, 19 km W of Cairns, 11.ix.1970, *C.H. Gittins 2208* (BRI); Atherton Tableland, Gadgarra, iii.1932, *W.D. Froncis s.n.* [AQ 109227] (BRI); 12 km N along the perimeter road from its junction with the Gillies Hwy (Atherton to Gordonvale road), 14.x.1987, *D.B. Foreman 1697* (AD, BRI, CANB, MEL, NSW, QRS); Elinjia Logging Area, 7.4 km NE of Millaa Millaa, x.1988, *L.W. Jessup et al. GJM2140* (BRI). NORTH KENNEDY: Kirrama Range, W of Kennedy, 31.vii.1947, *L.S. Smith 3212* (BRI); 6 km NW of Paluma, 26.ix.1992, *A.R. Beon 5040* (BRI, K, L, MEL, NSW); Bluewater S.F., NW of Townsville, 4.x.1992, *A.R. Beon 5078* (BRI, K, L, MEL).

4. *Alphitonia petriei* Braid & C.T.White in Braid, *Bull. Misc. Inform. Kew* 178 (1925).

Type citation: 'Johnston River, *Ladbrook* 46*; Kuranda, *White* (1525) 43*'. ***Type:*** Queensland. Johnstone River, x.1917, *H.G. Ladbrook 46* (lectotype K, here designated; isolectotype BRI [AQ 317594]).

Illustrations: S. Pearson and A. Pearson, *Rainforest Plants of eastern Australia* 24 (1992), both photos; P. Radke, A. Radke, G. Sankowsky and N. Sankowsky, *Growing Australian Tropical Plants* 17 (1993); Logan River branch SGAP, *Mangroves to Mountains*, 2: 288 (2005); G.J. Harden *et al.*, *Rainforest Trees and shrubs, A field guide to their identification* 152 (2006); N. Nicholson and H. Nicholson (2007). *Australian Rainforest Plants I* (6th ed.) p. 6 (2007); R. Melzer and J. Plumb, *Plants of Capricornia* 285 (2007).

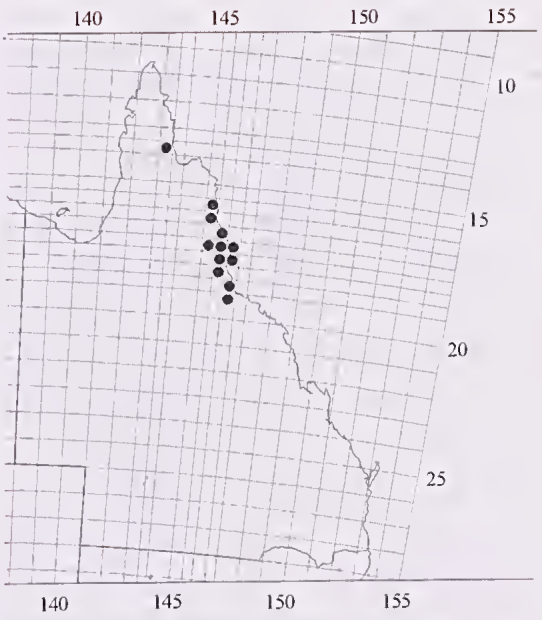

Figure 3. Distribution of *Alphitonia whitei* in 0.5° grids.

Tree 4–15 m high, bark smooth, dappled white and grey. Crown with numerous spreading, horizontal *branches*. *Branchlets* strongly ridged near growing point. Stipules 1–2(–4) mm long. Juvenile stem *indumentum* not known. Juvenile *leaves* broadly elliptical, c. 14 × 6.5 cm. Adult stem *indumentum* absent or sparse, hairs all crisped (no straight hairs), white, 0.05–0.1 mm high. *Leaves* 2-ranked, narrowly-elliptic, 8.6–17.1 × 3–5.7 cm (L/B ratio 2.5–3.1), apex acute, sometimes shortly mucronate; base usually broadly cuneate, rarely obtuse, symmetrical or asymmetrical; newly expanding leaves dark brown; petioles 1.2–2.1 cm long, with hairs c. 0.1 mm long. Upper leaf surface dark green, glossy, glabrous except when very young, when numerous brown tortuous hairs cover the surface; lower leaf surface with abundant tiny white crisped hairs in the areoles, obscuring the lamina, and sparse to dense brown tortuous hairs to 0.25 mm long along the midrib, secondary veins and veinlets. *Cymes* occurring in upper leaf axils, each 4–11 cm long, none truly terminal (terminal only by abortion of the terminal vegetative shoot). Pedicels 3–5.5 mm long at anthesis. Bracts and bracteoles extremely small, brown, linear. *Flowers* 4.0–5.2 mm across; sepals deltate, 1.5–1.9 mm long, 1.1–1.6 mm wide at base, glabrous internally; petals white, 1.4–1.8 mm long; filaments 1.3–1.8 mm

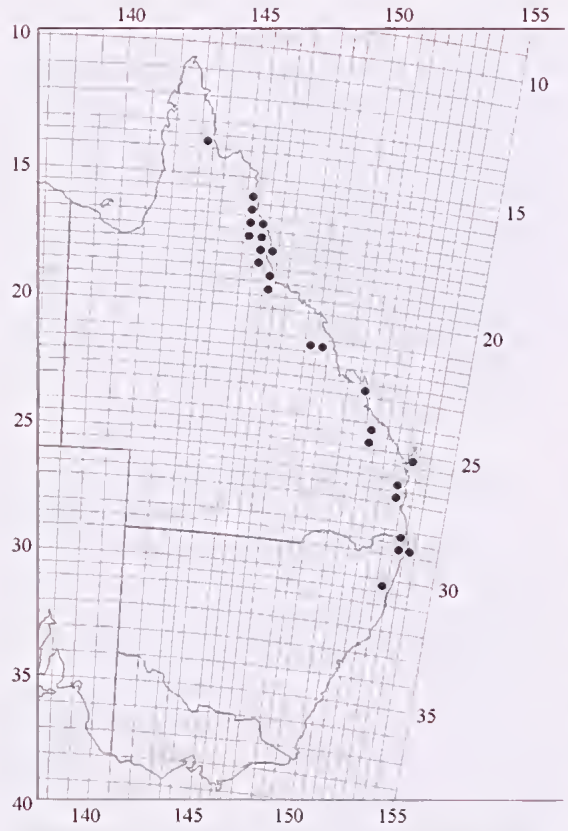

Figure 4. Distribution of *Alphitonio petriei* in 0.5° grids.

long, anthers 0.3–0.5 mm long, tail c. 0.1 mm long. Disc pentagonal, grey, not papillose, surface flat or undulate, radial furrows obscure or absent, glabrous except for inner one-third, having brown hairs overlying white flexuose trichomes close to style. Style (2–)3(–4)-fid, 0.7–1.3 mm long after elongation, lower part hairy. Fruiting pedicels 3.5–6 mm long, 0.5–0.6 mm diameter at midpoint. *Fruits* black at maturity, rather glossy, glabrous, oblate, (2–)3(–4)-locular, 8–9.5 mm long, 13–14 mm diameter, calyx scar close to pedicel end; powdery mesocarp abundant. Endocarpids 4.5–5.5 mm long (excluding apiculum), c. 4.2 mm wide (when open), radius 3–3.3 mm, apiculum 0.7–1.4 mm long, terminal. Aril maroon; seed grey, 2.9–3.4 × 2.1–2.5 × 1.5–1.8 mm. *Sarsaparilla, Pink Ash, White Ash.*

Distribution and habitat: *Alphitonia petriei* is endemic to Australia, with a discontinuous distribution along the east coast, being absent from lower rainfall areas. It extends from the MacIlwraith Range in far north Queensland to Lennox Head in northern New South Wales, and was reported by Floyd (1989) to also occur near the Orara River west of Coffs Harbour (Fig. 4). It grows along the margins of notophyll rainforest or as a pioneer species in rainforest regrowth. In north Queensland, it occurs most commonly between altitudes 800 and 1200 metres, although it has been recorded on top of Mt Bellenden Ker (1600 m) and extends almost to sea level where rainfall is high enough. In southern Queensland and New South Wales, it does not exceed 550 metres altitude.

Phenology: *Alphitonia petriei* flowers between August and November (September to November in southern Queensland and New South Wales), while ripe fruits and/or persisting seeds are found from December to May.

Typification: Braid (1925) indicated two type specimens in the protologue (*Ladbrook 46* and *White 43*). The Ladbrook specimen at K is chosen as the lectotype. It consists of a flowering branchlet and a single leaf separately mounted. It is duplicated at BRI, whereas *White 43* is present only at K.

Notes: *Alphitonia petriei* is comparatively distinctive because of its very small stipules, ribbed branchlets and small seeds. In the field, it may be readily confused with *A. oblata*; both have pagoda-like branching and are of similar size and stature, and both have conspicuously oblate fruits. However, *A. petriei* has a very different flowering time, and the indumentum is darker brown and is more quickly lost from the stems. In north Queensland, *A. petriei* prefers higher altitude sites, although the two species do sometimes occur together.

Selected specimens examined: **QUEENSLAND.** COOK: TR 14 [MacIlwraith Range], 18.ix.1975, *B. Hyland 3272* (BRI); c. 2 km SW of 'The Pinnacle', 13 km SSE of Mossman, iv.1978, *V.K. Moriarty 22B9* (QRS); 2 miles [3 km] west of Rumula, Mt Lewis range, 8.x.1964, *R. Schodde 4142* (BRI); Malanda, 22.viii.1943, *S.T. Bloke 15173* (BRI); Garners Beach Rd., 6 km NNW of Clump Point, 33 km SSE of Innisfail, 20.ix.1993, *D.G. Fell DGF3597 & M. Geyle* (BRI, CANB, MEL). NORTH KENNEDY: Coochembeerum area near Ravenshoe, viii.1962, *L.J. Webb & J.G. Trocey 61B2* (BRI); Princess Hills section of Lumholtz N.P., 314 km NNW of Charters Towers, 5.ix.2002, *M.B. Thomos 2395* (BRI, DNA); 6 km NW of Paluma, 26.ix.1992, *A.R. Beon 5043* (BRI, K, MEL). SOUTH KENNEDY: Mount Blackwood, c. 25 km NW of Mackay, close to TV transmitter, 26.xi.1986, *P.R. Shorpe 4555 & G.N. Botionoff* (BRI, CANB, NSW); Dalrymple Heights, vii–xi.1947, *M.S. Clemens s.n.* (BRI [AQ 109200]). PORT CURTIS: Byfield, N of Yeppoon, near Upper Stony Creek, 20.iii.1997, *J. Plumb*

JP39 (BRI); Timber Reserve 353, west of Many Peaks, 9.xi.1995, *A.R. Bean 9132 & G. Turpin* (BRI, MEL). BURNETT: Kroombit Tops, Cedarvale road, 20.vii.197B, *W.J. McDonald 2283 & J.P. Stonton* (BRI). WIDE BAY: Fraser Island, x.1921, *C.T. White 1198* (BRI); Goods Road, Conondale range, SF 274, 1B.x.19B2, *W.J. McDonold 3574 & J.B. Willioms* (BRI, NSW); 6.7 km NE of Kin Kin, 9.x.1993, *A.R. Bean 6768* (BRI, CANB, MEL). MORETON: Rocky Creek, 3 km W of Wappa Dam, near Yandina, 6.iii.1993, *A.R. Bean 5814* (BRI); Upper Mudgeeraba Creek, c. 12 km SW of Mudgeeraba, 26.x.1976, *W.J. McDonald 1642 & J.A. Elsol* (BRI). **NEW SOUTH WALES.** NORTH COAST: Dungay Creek, N of Murwillumbah, 1.x.19B0, *A.G. Floyd 1593* (BRI, NSW); Terania Creek, 14.ii.19B0, *A.G. Floyd 1431* (BRI); c. 6 km N of Lennox Head on road to Byron Bay, 5.xi.19B1, *J.B. Willioms s.n.* (BRI [AQ 510594], NE, NSW).

5. *Alphitonia oblata* A.R.Bean, *sp. nov.*

A. excelsae *affinis sed conopeo patente* e *ramis horizontalibus in stratis dispositis constanti, foliis longioribus oblongis apicibus breviter acuminatis, ovario semper 3-loculari* et *fructibus conspicue oblatis usque ad 15 mm diametro differens.*

Type: Queensland. NORTH KENNEDY: Bruce Highway, 10.5 km NNE of Tully, 30 December 1992, *A.R. Bean 5324* (holotype BRI; isotypes K, MEL).

[*A. incana auct. non* (Roxb.) Kurz; Hyland et *al.* (2002); Bean (2007)]

Illustrations: G.M. Wightman and M. Andrews, *Plants of the Northern Territory Monsoon Vine forests* 19 (1989), as *A. excelsa*; Logan River branch SGAP, *Mangroves to Mountains*, 2: 245 (2005), as *A. incana*; G.J. Harden et *al.*, *Rainforest Trees and shrubs, A field guide to their identification* 152 (2006), as *A. incana*.

Tree 6–15 m high. Bark smooth, dappled, blotchy, white and grey. Crown with numerous spreading, horizontal *branches*. Branchlets ridged near growing point; stipules linear, 2–6 mm long. Juvenile stem *indumentum* moderate to dense, with small white crisped hairs 0.1–0.2 mm high, and more-or-less straight, patent or antrorse, pale brown or rusty hairs to 1.0 mm long. Juvenile *leaves* narrowly-ovate to ovate, to c. 20 cm long. Adult stem *indumentum* sparse to dense, hairs all crisped (no straight hairs), pale brown to creamy-white, 0.1–0.2 mm high. *Leaves* 2-ranked, narrowly-ovate, narrowly-oblong or oblanceolate (more-or-less parallel-sided), 12.8–19 × 4.5–7.0 cm (L/B ratio 2.4–3.4), apex shortly acuminate, often with short mucro, sometimes acute; base frequently obtuse, sometimes cuneate or rarely cordate, symmetrical or rarely oblique; newly expanding leaves pale to mid-brown; petioles 1.0–1.8 cm long, hairs c. 0.2 mm long. Upper leaf surface dark green, glossy, glabrous except when very young, when numerous brown tortuous hairs cover the surface; lower leaf surface with abundant tiny white crisped hairs in the areoles, obscuring the lamina, and brown tortuous hairs to 0.5 mm long along the veins and veinlets. *Cymes* occurring in up to 9 leaf axils per branchlet, 6–12 cm long, none truly terminal. Pedicels 2.0–4.5 mm long at anthesis. *Flowers* 4.5–6.2 mm across; sepals deltate, 1.5–2.0 mm long, 1.3–1.6 mm wide at base, glabrous internally; petals white, 1.1–1.8 mm long; filaments 1.2–1.8 mm long, anthers 0.3–0.5 mm long, tail 0.1–0.2 mm long. *Disc* pentagonal, grey, covered by minute papillae, radial furrows present, 10; inner half of disc with dense erect brown hairs overlying tiny white crisped hairs. *Style* consistently 3-fid, 1.0–1.3 mm long after elongation. Fruiting pedicels 3–4 mm long, 0.7–0.8 mm diameter. Mature *fruits* black, somewhat glossy, glabrous, oblate, 3-locular, 9–11 mm long, 13–15 mm diameter, soon disintegrating, calyx scar close to pedicel end; powdery mesocarp abundant. Endocarpids (when opened) 6.5–8 mm long (excluding apiculum), 6.5–7.5 mm wide, radius 3.5–4 mm, apiculum 1–2 mm long, terminal. Aril maroon; *seed* grey to black, 4.0–5.0 × 3.5–4.4 × 1.8–2.3 mm. Fig. 5.

Distribution and habitat: *Alphitonia oblata* occurs along the Queensland coast from Bamaga to Buderim, and in parts of Northern Territory and the Kimberley region of Western Australia (Fig. 6). It inhabits rainforest edges or canopy breaks where annual rainfall exceeds around 1500 mm, although it may occur in sheltered gorges where rainfall is lower. It is usually found at altitudes of less than 200 metres, but may occasionally be found up to 500 metres above sea level.

Phenology: In Queensland it flowers from March to May, while ripe fruits and/or persisting seeds are found from August to February. In Northern Territory and Western Australia it flowers from February to April and ripe fruits and/or persisting seeds are found from June to September.

Notes: Specimens of *A. oblata* from between Cairns and Buderim in Queensland have more-or-less

Figure 5. *Alphitonia oblata*. A. flowering branchlet × 0.4 (*Bean 18708*, BRI); B. flower from above × 7 (*Bean 18708*, BRI); C. mature fruit from above × 2 (from photo of fruits of *Bean 5774*, BRI); D. mature fruit, lateral view × 2 (from photo of fruits of *Bean 5774*, BRI); E. endocarpid, enclosing arillate seed × 6 (*Bean 5731*, BRI); F. fully expanded endocarpid × 6 (*Bean 5731*, BRI); G. seed with aril removed × 8 (*Bean 5731*, BRI).

parallel-sided adult leaves with a shortly acuminate apex and relatively long stipules, while specimens from Cape York Peninsula, Northern Territory and Western Australia tend to have narrowly-ovate adult leaves with an acute apex, and shorter stipules.

The shape of the mature fruits in *A. oblata* and *A. petriei* is the same, and yet *A. oblata* can be readily distinguished by the larger endocarpids and larger seeds.

Etymology: The specific epithet is from the Latin *oblatus* meaning 'flattened at the poles'. This is a reference to the shape of the mature fruit in this species.

Selected specimens examined: **WESTERN AUSTRALIA.** Mornington Wildlife Sanctuary, NE of Fitzroy Crossing, 20.iv.2005, *S. Murphy MULE421 & S. Legge* (BRI). **NORTHERN TERRITORY.** 19 miles [31 km] NW of Mountnorris Bay, 17.vii.1961, *G.M. Chippendale 8163* (BRI); Butterfly Gorge, 29.ix.1991, *M.J. Barritt 909* (AD, BRI, CANB, DNA, K, L, MEL, MO); Angurugu River, Groote Eylandt, 27.ix.19B1, *F.R. Fosberg 62384 & R.C. Buckley* (BRI); Wessel Islands, 2B.ix.1972, *P.K. Latz 3221* (BRI, DNA). **QUEENSLAND.** COOK: West side of Cape York road, 6 km N of turnoff near Bamaga, 27.viii.1989, *P.C. Jobson 758 & G.C. Power* (BRI, MEL); Currunda Creek, 9 km W of Cairns, 30.i.1993, *A.R. Bean 5731 & P.I. Forster* (BRI); Russell River, N.P. 1353, 15.x.19B1, *B. Gray 2187* (BRI, QRS); near Japoon, 22.iv.1959, *R.F. Thorne 20719 & W.T. Jones* (BRI); 4 km W of Cook Hwy along Kennedy Hwy, Macalister Range, 4.xii.1991, *D. Halford Q792* (AD, BRI, CANB, DNA, MEL, N5W); NPR 1353, Bellenden Ker, 19.viii.19B1, *B. Hyland 11108* (BRI, QR5); Golf Course St., El Arish, N of Tully, 17.iv.2002, *A.R. Bean 18708* (BRI, NY). NORTH KENNEDY: Cardwell Range, 12 km N of Ingham on Bruce Highway, 24.xi.1992, *A.R. Bean 5256* (BRI, DNA, L). SOUTH KENNEDY: 12.6 km from Gargett, towards Mt Charlton (W of Mackay), 15.iv.2002, *A.R. Bean 18671* (BRI, DNA, L); Dolphin Heads, Mackay, 26.ix.1994, *G.N. Batianoff 94099 & S. Saltman* (AD, BRI, L). MORETON: Gold Creek, North Arm, near Nambour, 12.ix.1993, *A.R. Bean 6517* (BRI, CANB, DNA, L, MEL); Dunethin Rock, 6 km E of Yandina, 17.ii.1993, *A.R. Bean 5774* (BRI, N5W); Mons Road, Buderim, 29.iii.1993, *A.R. Bean 5890* (BRI, BI5H, DNA, K, L, MEL).

Excluded names

***Alphitonia franguloides* A.Gray, *Bot. U.S. Expl. Exped.* 1: 280 (1854);** *A. excelsa* var. *franguloides* (A.Gray) F.M.Bailey, *Compr. Cat. Queensland Pl.* 837 (1913).

When naming *A. excelsa* var. *franguloides*, Bailey stated 'this is the *A. franguloides*, Gray, ...'. Hence Bailey's name must be interpreted as a new combination rather than a new taxon, and the type of Bailey's name is that of *A. franguloides*. The latter was named from Fiji, and is a small-leaves species that is thought to be endemic to that island nation. No specimens matching *A. franguloides* are known from Australia. The Australian specimens cited by Bailey are *A. whitei*.

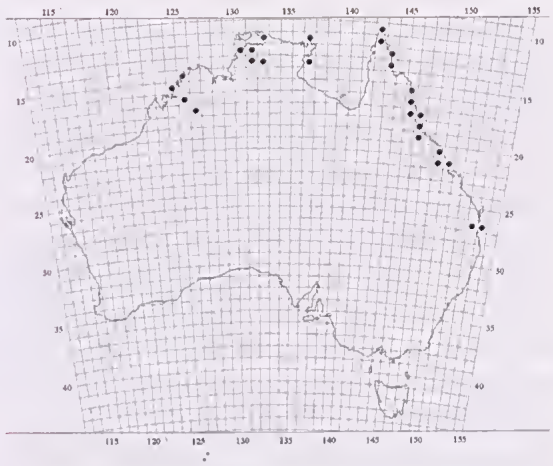

Figure 6. Distribution of *Alphitonia oblata* in 1° grids.

***Alphitonia incana* (Roxb.) Kurz, *J. Bot.* 11: 208 (1873)**

Rhamnus incanus Roxb., *Fl. Ind. (Roxburgh)* 2: 350 (1824), 1: 603 (1832). *Type citation:* 'Reared in the botanic garden at Calcutta from seed received from the Moluccas.' ***Type:*** without location, without date, *W. Roxburgh s.n.* (lectotype BR [506281], here designated; isolectotype K-WALL no. 4261).

The protologue for *Rhamnus incanus* includes a fairly detailed description of the plant, compiled from a live specimen growing at the Calcutta Botanic Gardens, from seed received from the Moluccas. The known extant original material comprises 1. a Roxburgh drawing (n. 1371) held at Kew; 2. a specimen in the Wallich herbarium at Kew; and 3. a specimen in the Roxburgh herbarium at Brussels (Forman 1997).

The drawing is somewhat stylised and probably does not accurately portray the features of the plant, and it is certainly not a good match for the two specimens noted above. It includes a transverse view of a fruit, which appears to be somewhat oblate; the leaves in the drawing are narrowly ovate on very short petioles, and the stipules very long and slender.

The specimen at BR comprises a pressed and mounted branchlet, bearing several leaves and a few inflorescences. It bears both flower buds and open flowers. All of the flowers have 3-fid styles. This specimen is fully in accord with the protologue and is here chosen as the lectotype of the name.

The specimen in the Wallich herbarium has not been examined by the present author, but the microfiche (K-WALL no. 4261) has been seen. It appears almost identical to the Brussels specimen in leaf size and shape; shape of leaf base and apex; size, placement and maturity of inflorescences; and even size and shape of the specimen as a whole. It is here considered part of the same gathering. It is unfortunate that neither of the original specimens bears fruits, as most taxonomically useful characters are associated with the fruits. In the protologue, Roxburgh described the fruits thus: 'Berries round, ..., the size of a small cherry, when ripe black'.

I have examined two fruiting specimens from the Moluccas Islands (*Kostermans 1221* (BRI); *Kostermans 925* (BRI)). These specimens have consistently 3-locular fruits (hence in accord with the lectotype which has flowers with 3-fid styles). The mesocarp and exocarp of these fruits have disintegrated, indicating that the fruits are fully mature, but also masking the original shape of the fruits. Judging by the small quantity of mesocarp material present, the intact fruits are likely to have been globular or perhaps slightly oblate. The endocarpids are 4.4–5.2 mm long with an apiculum 0.4–0.7 mm long. The seeds are grey, 3.4–3.6 mm long and 2.7–2.9 mm wide. The leaves have a cuneate base, and an acute or rarely slightly acuminate apex, and the stipules brown, linear, c. 3 mm long. In these vegetative features, the two Kostermans specimens are an excellent match for the lectotype.

There is no doubt in my mind that these specimens belong to *Alphitonia incana sens. str.* Other specimens matching the lectotype occur in the Moluccas and lowland areas of New Guinea, but the shapes and measurements given above are at odds with specimens from Australia that have previously gone by the name *A. incana*. Therefore, the Australian taxon has been described in this paper as a new species (*A. oblata*). The precise distribution and ecology of *A. incana sens. str.* will become clear only upon a revision of the Malesian species.

Alphitonia moluccana Braid, *Bull. Misc. Inform. Kew* 184 (1925).

Braid (1925) cited one Australian specimen under the name of *A. moluccana*, *i.e.* 'Cairns, C.T. White 35'. This specimen is held at BRI and represents *A. oblata*. A type specimen of *A. moluccana*, collected by J.E. Teijsmann from the Moluccas islands, is present at K. There are apparently no types for that name at L or BO. The Kew specimen is in flower, but bears no fruits. Its leaves are very broad (measuring c. 16 × 9 cm), some are conspicuously cordate at the base, and petioles c. 1.3 cm long with short rusty tomentum. Since the branchlet that bears these leaves is a flowering one, the specimen was evidently not from a juvenile plant. These leaves are broader and more cordate than any to be found on flowering plants of *A. oblata*, and so it is concluded that these species are not synonymous. In fact, none of the Indonesian or New Guinean specimens at BRI matches the leaf dimensions and indumentum pattern of the syntype of *A. moluccana*. It may prove to be a species of restricted distribution, perhaps endemic to the Moluccas.

Hoogland (1960) placed *A. moluccana* into synonymy with *A. incana*, and the latter name has been widely misapplied in Australia to *A. oblata*.

Alphitonia philippinensis Braid, *Bull. Misc. Inform. Kew* 183 (1925).

This name was first used for Australian populations of *Alphitonia* by White (1939). Australian specimens determined by White as *A. philippinensis* are considered by the current author to be *A. excelsa*. The name *A. philippinensis* was later misapplied to specimens of *A. oblata* (Hyland *et al.* 2002). Kellermann and Thiele (2008, p. 33) stated 'all Australian material previously referred to *A. philippinensis* is *A. incana* (Roxb.) Teijsm. & Binn. ex Kurz, and it is possible that the two taxa are conspecific'. Whether *A. philippinensis* and *A. incana* are conspecific remains to be seen, but certainly neither name is applicable in Australia.

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I am grateful to Juergen Kellermann (AD) for sending images of type specimens, to the Director of the herbarium at the National Botanic Garden of Belgium (BR) for the loan of the type of *Rhamnus incanus*, and to Tony Orchard (Australian Botanical Liaison Officer 2008–09) for sending an image of the Roxburgh drawing of *Rhamnus incanus*. Will Smith (BRI) produced the illustrations and distribution maps, and Peter Bostock (BRI) translated the diagnosis of *A. oblata* into Latin.

References

Balgooy, M.M.J. van (1966). Pacific plant maps. *Blumea, Supplement V*: B2–3.

Bean, A.R. (2002). Rhamnaceae. In R.J. Henderson (ed.), *Names and distribution of Queensland plants, algae and lichens*, pp. 171-172. Queensland Herbarium, Environmental Protection Agency: Brisbane.

Bean, A.R. (2007). Rhamnaceae. In P.D. Bostock and A.E. Holland (eds), *Census of the Queensland flora 2007*, pp. 307-309. Queensland Herbarium, Environmental Protection Agency: Brisbane.

Bentham, G. (1863). *Alphitonia*. In Bentham, G., *Flora Australiensis*, vol. 1, p. 414. L. Reeve and Co.: London.

Booth, R., Harwood, R.K. and Mangion, C.P. (2001). *Field key for the monsoon rainforest flora of the Darwin Region*. Northern Territory University Press and The Herbarium: Darwin.

Braid, K.W. (1925). Revision of the genus *Alphitonia*. *Bulletin of Miscellaneous Information Kew 1925*, 163–186.

Endlicher, S.L. (1840). *Genera Plantarum secundum ordines naturales disposita*. Fr. Beck Universitatis Bibliopolam: Vienna.

Fairbairn, E. (1999). *Australian timbers*, vol. 2: *Western Queensland trees and their timbers*. Department of Natural Resources: Indooroopilly.

Fay, M.F., Lledó, M.D., Richardson, J.E., Rye, B.L. and Hopper, S.D. (2001). Molecular data confirm the affinities of the south-west Australian endemic *Gronitites* with *Alphitonia* (Rhamnaceae). *Kew Bulletin* **56**, 669–675.

Floyd, A.G. (1989). *Rainforest trees of mainland south-eastern Australia*. Inkata Press: Melbourne.

Forman, L.L. (1997). Notes concerning the typification of names of William Roxburgh's species of Phanerogams. *Kew Bulletin* **52**, 513–534.

Hallé, F., Oldeman, R.A.A. and Tomlinson, P.B. (1978). *Tropical trees and forests: an architectural analysis*. Springer-Verlag: Berlin.

Hoogland, R.D. (1960). The identity of *Glochidion ?cinerascens* Miq. and of *Rhamnus inconus* Roxb. *Kew Bulletin* **14**, 33.

Hyland, B.P.M., Whiffen, T., Christophel, D.C., Gray, B. and Elick, R.W. (2002). *Australian tropical rain forest plants: trees, shrubs and vines*. CD_ROM, Centre for Plant Biodiversity Research: Canberra.

Kellermann, J. and Thiele, K.R. (2008). Lectotypifications and nomenclatural notes on Rhamnaceae from northern Australia. *Journal of the Adelaide Botanic Gardens* **22**, 33–35.

Medan, D. and Schirarend, C. (2004). Rhamnaceae. In K. Kubitzki (ed.), *The families and genera of vascular plants, vol. VI*, pp. 320–338. Springer-Verlag: Berlin.

Richardson, J.E., Fay, M.F., Cronk, Q.C.B., Bowman, D. and Chase, M.W. (2000). A Phylogenetic analysis of Rhamnaceae using *rbcL* and *trnL-F* plastid DNA sequences. *American Journal of Botany* **87**, 1309–1324.

Rye, B.L. (1996). *Gronitites*, a new genus of Rhamnaceae from the south-west of Western Australia. *Nuytsia* **10**, 451–457.

Wheeler, J.R. (1992). Rhamnaceae. In J.R. Wheeler (ed.), *Flora of the Kimberley Region*, pp. 629-633. Department of Conservation and Land Management: Como.

White, C.T. (1939). Contributions to the Queensland flora, no. 6. *Proceedings of the Royal Society of Queensland* **50**, 66–87.

Grevillea victoriae subsp. *brindabella* (Proteaceae), a new subspecies from the Southern Tablelands of New South Wales

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Abstract

Grevillea victoriae F.Muell. subsp. *brindabella* Stajsic *subsp. nov.* is described as new. Apparently confined to the northern part of the Brindabella Range, Southern Tablelands, New South Wales, the known range of the subspecies is 10 km (between Waterfall Creek Falls and Genges Trig). Its ecology and conservation status are discussed. Taxonomic relationships with other subspecies of *G. victoriae* are considered.

Keywords: Proteaceae, taxonomy, Australia.

Muelleria 28(1): 18-28 (2010)

Introduction

Continuing studies in the *Grevillea victoriae* F.Muell. complex have revealed the presence of a new taxon in the Southern Tablelands of New South Wales. Although the works of Makinson (2000), Molyneux and Stajsic (2000), and Stajsic and Molyneux (2006) have resolved most of the taxonomic problems in the *G. victoriae* complex, the group continues to present some seemingly intractable problems (e.g. the polymorphic *G. oxyantha* Makinson). Stajsic and Molyneux (2006) alluded to the presence of further unnamed taxa within the complex, one of them being represented by three populations from the northern part of the Brindabella Range.

Makinson (2000) commented that the '8aldy Range' entity is closely related to (if not part of) *G. victoriae* subsp. *nivalis* Stajsic & Molyneux. The Australian Plant Census (accessed August 2009) follows the Makinson view, and lists *Grevillea* aff. *victoriae* 'Baldy Range' *sensu* Makinson (2000)/*Grevillea* aff. *victoriae* M. Richardson 9 (CBG8601975) sensu Makinson (2000) as part of *Grevillea victoriae* subsp. *nivalis*.

Stajsic and Molyneux (2006) acknowledged the similarity between the 'Baldy Range' population and *G. victoriae* subsp. *nivalis* but thought at the time, based on preliminary observations, that it was sufficiently different to constitute a separate species. Subsequent scrutiny of the 'Baldy Range' taxon confirms that it shares characters of both subspecies *victoriae* and *nivalis*, but that it cannot be accommodated into either. It is described here as a new subspecies. The degree of difference between the new taxon and the currently recognised subspecies of *G. victoriae* is more or less equivalent.

Materials and methods

Forty-three herbarium specimens from MEL and NSW were examined and measured, including spirit material held at MEL. Where possible, at least

five plants per site were sampled. A total of 3–5 flowers and 10 leaves per herbarium specimen were measured. Measurements of floral characters are based on both live material held in the living collections at the Royal Botanic Gardens Melbourne, and rehydrated flowers from herbarium specimens. Spirit-preserved specimens were not employed for morphometric measurements as they become inflated due to absorption of liquid, although they were used for qualitative data such as the shape of the pollen-presenter in cross-section. The colour of vegetative and floral parts is based on live material. Supplementary observations and measurements were made from the living collections held at the Royal Botanic Gardens Melbourne. The images were taken using an Olympus SZX16 dissecting microscope and the Olympus DP71 digital camera. Distribution maps were generated using ArcGIS 9.1. Descriptive terminology follows McGillivray and Makinson (1993), and Makinson (2000), except for a few terms that are outlined in Stajsic and Molyneux (2006). Conservation codes are assigned according to both ROTAP (Briggs & Leigh 1996) and IUCN (2001) criteria.

Taxonomy

Grevillea victoriae F.Muell. subsp. *brindabella* Stajsic, *subsp. nov.*

A subsp. victoriae *foliis supra paginis nitentibus minoribus relative latioribus, rachibus inflorescentiarum brevioribus ed indumento perianthii subsericeo differt; a subsp. nivalis indumento ramuli sericeo vel subsericeo, foliis paginis non reticulatis, indumento inferno paginae sericeo concinno differt; ab ambabo floribus minoribus, indumento perianthii subsericeo differt.*

Grevillea aff. *victoriae* 'Baldy Range' sensu Makinson (2000)

Grevillea aff. *victoriae* M. Richardson 9 (CBG8601975) sensu Makinson (2000)

(n.b. Makinson (2000) gave the above two phrase names as possible alternative names for the same taxon, and not for two different taxa.)

Type: New South Wales, Southern Tablelands, (ca. 200 metres N from the ACT border), Brindabella Range, immediately to the W of Genges Trig. 27.ix.2002, *V. Stajsic* 3016 & *R.G. Coveny, A.E. Orme* (holotype: MEL 2237187–2237188!; isotypes: CANB!, NSW!) (Fig. 1).

Spreading to erect *shrub* to 1.2–2.5 m high, 1–4(–6 m) across. *Branchlets* terete to subterete, angular or biconvex in cross-section, with several longitudinal ridges; densely sericeous, or occasionally ± subsericeous, the indumentum of biramous non-glandular hairs, epidermis not visible, straight, silvery-white and/or with scattered irregularly aligned, appressed or slightly ascending ferruginous and tan hairs. *New growth* ferruginous soon becoming wholly green, or green suffused with purplish-pink or salmon-pink, soon becoming wholly green. *Leaves* ascending (towards apex of branchlets), petiolate, simple, entire, usually narrowly to broadly lanceolate, occasionally ovate or elliptic, sometimes on the same plant, (20–)40–60(–85) mm long, (5–)12–18(–32) mm wide, the lamina flat to broadly U-shaped or V-shaped in cross-section, can be variable on the same plant, (apex usually acute with a short blunt mucro or occasionally obtuse), *margins* very narrowly recurved; leaf length to width ratio (2.0:1–)2.5:1–3.5:1(–4.0:1); *leaf upper surface* minutely foveolate, glabrous or sericeous just above petiole, the indumentum of biramous non-glandular, silvery-white hairs, with or without occasional irregularly aligned tan or ferruginous overlying hairs, the leaf lamina usually distinctly glossy, mid green or dark green; *lateral veins* usually evident to conspicuous, *reticulum* absent; *leaf lower surface* densely sericeous or subsericeous (as for branchlets); *lateral veins* obscure or evident, *reticulum* absent; *leathery-textured*. *Conflorescence* terminal or axillary, decurved, pedunculate, simple to twice-branched, 50% simple, 32% once-branched, 18% twice-branched; *unit conflorescence* cylindrical or a dome-shaped cluster, acropetal; number of flowers (20–)38–50(–64) per unit conflorescence; *distance between flower pair scars (post-anthesis) at middle of floral rachis* 0.7–2 mm; *primary peduncles* (0–)4–15 mm long, 1.2–1.5 mm wide, indumentum moderately densely sericeous or occasionally ± subsericeous, of biramous non-glandular hairs, epidermis not visible or partially visible, the indumentum silvery-white or off-white, occasionally with ascending tan and ferruginous hairs, some plants also with minute (0.3–0.5 mm long), patent, colourless, translucent glandular hairs (most readily observed in live material, difficult to observe in dried specimens), overall colour (as in rachises) usually white or off-white, occasionally greenish-white; *floral*

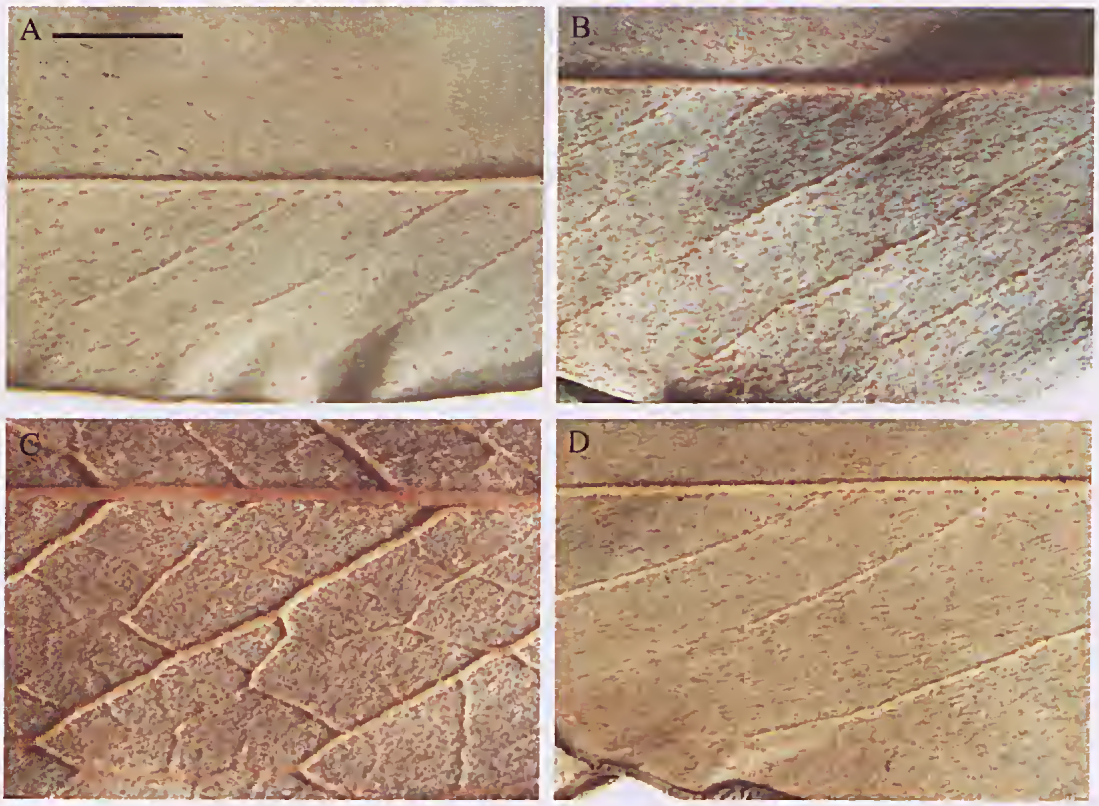

Figure 1. Leaf lower surface venation: A. *Grevillea victoriae* subsp. *brindabella* (VS 2598); B. *G. victoriae* subsp. *brindabella* (VS 2598); C. *G. victoriae* subsp. *nivalis* (B.J. Conn 1441); D. *G. victoriae* subsp. *victoriae* (P.G. Neish 520). Scale bar = 5 mm (mag. 0.7 ×10).

rachises (14–)25–50(–60) mm long, indumentum as for peduncles; *floral bracts* narrowly triangular, 1.5–2.0 mm long, 0.4–0.7 mm wide, crescentic in side-view, basally truncate, apex acute but blunt-tipped, outer surface densely subsericeous of biramous non-glandular hairs, the hairs predominantly silvery-white or off-white, or a mixture of pre dominantly off-white and tan hairs with scattered ferruginous hairs, overall colour silvery-white, or tan, never wholly ferruginous, the inner surface glabrous except near apex, brown or dark brown, bracts persistent until buds 1.2–1.5 mm long; *pedicels* 4–5 mm long, indumentum usually as for perianth below the limb, or with a greater abundance of tan hairs, or indumentum denser, usually eglandular or sometimes with minute (0.3–0.5 mm long) spreading glandular hairs; torus oblique to pedicel at 30–45° angle; *very early flower buds with the perianth below the limb* pale ferruginous, tan or slightly salmon-pink, perianth below the limb maturing to red, limb ferruginous, maturing to light ferruginous, eglandular or some plants also with minute, patent, colourless, translucent glandular hairs 0.5–1.0 mm long; *advanced buds* acroscopic, maturing to ± acroscopic to variably retrorse; *perianth below the limb* squarish with rounded angles in cross-section; *perianth outer surface below the limb* moderately densely subsericeous, of biramous non-glandular hairs, the indumentum predominantly silvery-white with occasional tan hairs, with scattered irregularly aligned silvery-white or ferruginous hairs (in herbarium specimens the indumentum is a mixture of ferruginous off-white and silvery-white hairs), some plants also with minute (0.3–0.5 mm long), patent, colourless, translucent glandular hairs, overall perianth colour red; *perianth inner surface epidermis below the limb* minutely papillate above beard, glabrous except for beard, red or reddish-pink; *perianth limb* round in side-view, squarish face-on, obtuse or slightly subacute, 2.2–2.5 (–3.0) mm across in side-view, limb segments slightly midline-keeled on outer surface, densely subsericeous, of biramous non-glandular hairs, the indumentum predominantly tan and ferruginous, with or without off-white and dark reddish-ferruginous hairs, epidermis

red or reddish-pink; *dorsal tepal beard* commencing 1.5–2.3 mm above toral rim, extending for 4.0–4.5 mm, hairs 1.2–1.5 mm long; *ventral tepal beard* commencing 4.0–5.0 mm above toral rim, extending for 2.0–2.5 mm, hairs 1.0–1.2 mm long; *dorsal tepals* 16–19 mm long, 1.9–2.4 mm wide; *nectary* half-annular, projecting 0.4–0.7 mm above toral rim, margins entire, pale yellow; *pistil* 16–19 mm long; *stipe* 1.5–2.7 mm long, glabrous; *ovary* usually glabrous or in some plants with scattered, patent, simple non-glandular, silvery-white hairs (appear to be present post-anthesis) of variable length to 0.4 mm long, or a mixture of hairs and scabrosities, or with a few longitudinally aligned, appressed, biramous hairs (in Baldy Range Fire Trail population), ovary green or greenish-yellow; *style* exserted from dorsal suture of perianth before release of style-end, bowed, afterwards nearly straight to slightly incurved, with scattered minute spreading simple hairs in the upper 2/3–1/2 of style length, particularly at back of style-end, red or reddish-pink; *pollen presenter* oblique to style, 2.7–3.0 mm long, 2.0–2.4 mm wide; *face of pollen presenter* slightly convex in cross-section, base not concurrent with the style; *stigma* distally off-centre; *follicle* ovoid/ellipsoid, (15–)17–20 mm long, 5–7 mm deep, wall 0.7–1.0 mm thick, glabrous, faintly colliculose-rugulose, with several longitudinal ridges on each side, firmly crustaceous, style persistent. Figs. 1–7.

***Specimens examined*: NEW SOUTH WALES.** Southern Tablelands: 12.6 km from Mountain Creek Road on the Baldy Range Fire Trail, 23.vi.1986, *M.M. Richardson 8 & P. Ollerenshaw* (CANB; NSW); Brindabella National Park, Above Waterfall Creek Falls, 28.i.2002, *V. Stajsic 2597–2601* (CANB, NSW, MEL 2133233–2133365); Cultivated at Bywong Nursey, Bywong. Originally from Brindabella National Park, 12.6 km from Mountain Creek Road on the Baldy Range Fire Trail, ACT, 7.viii.2002, *P. Ollerenshaw s.n.* (MEL 2180257–2180262); Brindabella National Park, immediately to the W of Genges Trig, 27.ix.2002, *V. Stajsic 3014–3020 & R.G. Coveny, A. Orme* (AD, CANB, HO, MEL 2237181–2237190, MEL 2239991–2239998, MEL 2240002, NSW).

Distribution: *Grevillea victoriae* subsp. *brindabella* is endemic to the northern part of the Brindabella Range, north of the border between the Australian Capital Territory and New South Wales. It is known from three sites: Baldy Range Fire Trail (where it was first collected), Waterfall Creek Falls and Genges Trig. The greatest distance separating the known populations is between the Waterfall Creek Falls population and the Genges Trig population, which is ca. 10 km, and the shortest distance is ca. 4.5 km (between the Baldy Range Fire Trail and the Genges Trig populations) (Fig. 2).

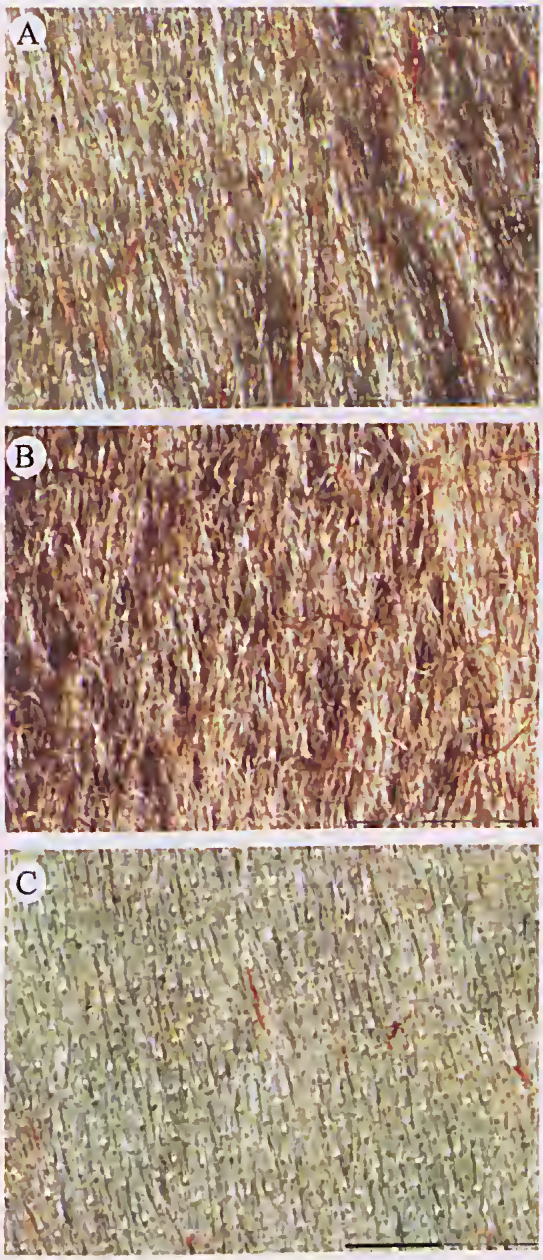

Figure 2. Leaf lower surface indumentum: A. *G. victoriae* subsp. *brindabella* (VS 2598); B. *G. victoriae* subsp. *nivalis* (N.G. Walsh 4890); C. *G. victoriae* subsp. *victoriae* (J.A. Jeanes 2005). Scale bar = 0.5 mm (mag. 5 × 10)

Grevillea victoriae subsp. *brindabella* is one of three members of the *G. victoriae* complex that occur in

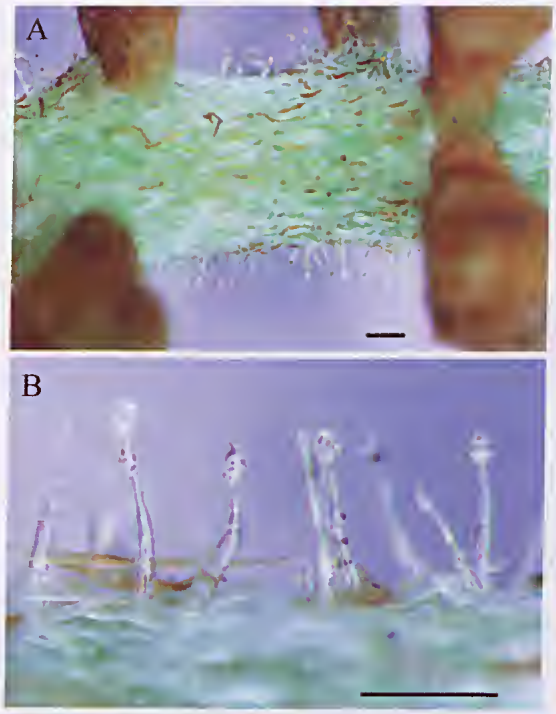

Figure 3. Floral rachis of *G. victoriae* subsp. *brindabella*: showing spreading glandular hairs. Live material, cultivated at Royal Botanic Gardens Melbourne (VS 2599). Scale bar = 0.5 mm (mag. A = 3.2 × 10; B = 11.5 × 10).

the Brindabella Range, the other being *G. diminuta* L.A.S.Johnson (which also occurs in the Bimberi Range), and *G. oxyantha* Makinson subsp. *oxyantha* (which is more widespread in the Southern Tablelands).

Habitat: *Grevillea victoriae* subsp. *brindabella* grows between 1000 and 1243 metres above sea level. At Waterfall Creek Falls, the plants grow in dry open forest with *Eucalyptus dives* Schauer, *E. mannifera* Mudie, *E. radiata* Sieber ex DC. and *E. rossii* R.T.Baker & H.G.Sm., with an *understorey* of *Joycea pallida* (R.Br.) H.P.Linder, *Cassinia aculeata* (Labill.) R.Br., *Dodonaea viscosa* (Sm.) J.G.West, *Platylobium* sp., *Hibbertia obtusifolia* DC., *Exocarpus cupressiformis* Labill., *Omphacomeria acerba* (R.Br.) A.DC., *Deyeuxia ?brachyathera* (Stapf) Vickery, *Pomaderris* sp., *Hardenbergia violacea* (Schneev.) Stearn, *Poa sieberiana* Spreng., *Derwentia perfoliata* (R.Br.) Raf., *Stellaria pungens* Brongn. and, *Dianella revoluta* R.Br. The geology at the site appears to include volcanic and sedimentary (sandstone/slate) elements.

At Genges Trig, *G. victoriae* subsp. *brindabella* grows in *Eucalyptus pauciflora* Sieber ex Spreng. woodland, with *E. dives* Schauer just below the summit, on rocky

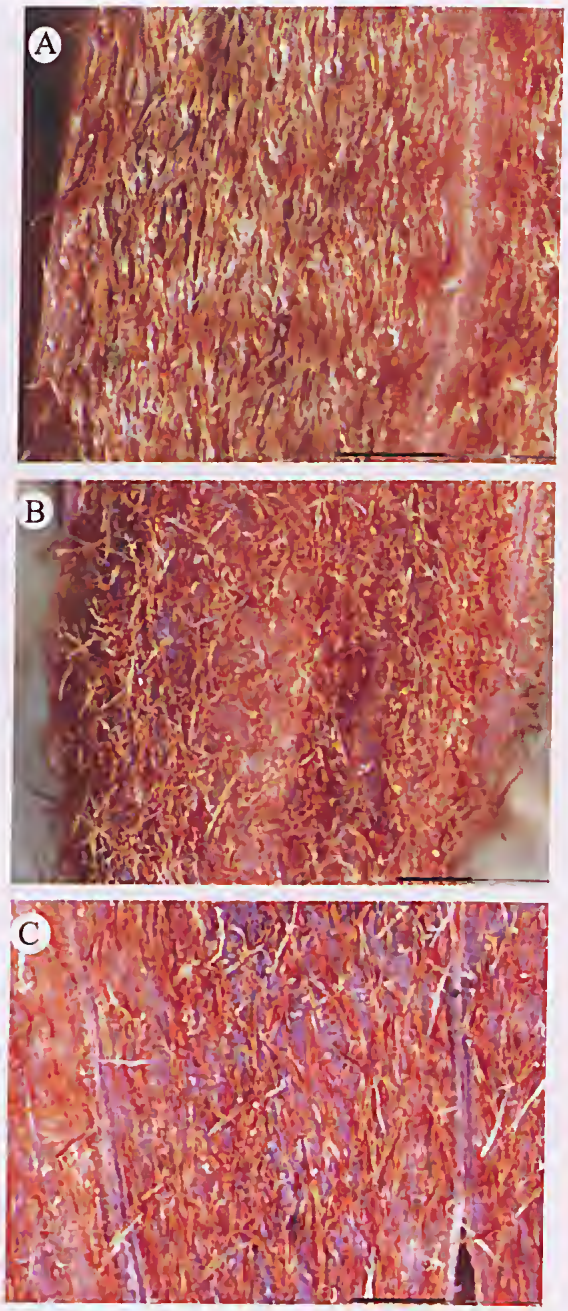

Figure 4. Perianth outer surface indumentum: A. *G. victoriae* subsp. *brindabello* (VS 3017); B. *G. victorioe* subsp. *nivalis* (VS 2520); C. *G. victorioe* subsp. *victorioe* (VS 2141). Scale bar = 0.5 mm (mag. A = 5 × 10; B = 4 × 10; C = 4.5 × 10).

outcrops, on reddish-brown soil, of sedimentary origin. The understorey consists of *Joycea pallida* (R.Br.) H.P.Linder, *Oxylobium ellipticum* (Vent.) R.Br., *Acrotriche serrulata* R.Br., *Monotoca scoparia* (Sm.) R.Br., *Leucopogon fletcheri* Maiden & Betche, *L. microphyllus*

(Cav.) R.Br. var. *pilibundus* (A.Cunn. ex DC.) Benth., *Hibbertia obtusifolia* DC., *Daviesia leptophylla* A.Cunn. ex Don., *Kunzea* sp., *Exocarpus cupressiformis* Labill., *Cassinia longifolia* R.Br. and *C. aculeata* (Labill.) R.Br. At the Baldy Range Fire Trail it is found on a steep N facing mountain slope, in low open woodland of *Eucalyptus pauciflora* Sieber ex Spreng., with an understorey of *Kunzea* sp., on volcanic geology.

It is assumed that, as is the case with other members of the complex, vegetative reproduction is unknown, and plants are killed outright by severe fire. Regeneration is therefore probably from seed only.

Conservation Status: *Grevillea victoriae* subsp. *brindabella* is entirely confined to Brindabella National Park. At the type locality there are several hundred adult plants, with occasional seedlings (Stajsic pers. obs. 2002). The type population is the largest known. At Waterfall Creek Falls site there are 50 adult plants. Three separate attempts (December 1996, January 2002 and February 2002) to relocate the Baldy Range Fire Trail population have been made by the author without success. Other attempts to relocate this population have been unsuccessful (Makinson pers. comm. 2002). The collecting notes on *Richardson 8 & Ollerenshaw* (CANB, NSW) indicate that the plants were common at the time of the original collection.

Based on current knowledge the new subspecies should be regarded as Endangered (EN sensu IUCN 2001), or Vulnerable (2Vit sensu Briggs & Leigh 1996). The major potential threat is probably too frequent fires, preventing plants setting fruit and exhausting the soil seed-bank.

Phenology: Flowering has been recorded between August and February, but it is possible that flowering occurs sporadically throughout the year. Nectarivorous birds, in particular honeyeaters of various species, visit the flowers, and it is assumed that the plants are primarily ornithophilous.

Etymology: From the locality Brindabella Range, the centre of known distribution of the subspecies; a name of somewhat obscure meaning. The epithet '*brindabella*' can be construed as either a noun in apposition, or as the ablative indicating the place of origin.

Notes: *Grevillea victoriae* subsp. *brindabella* differs from both subsp. *victoriae* and subsp. *nivalis* in having

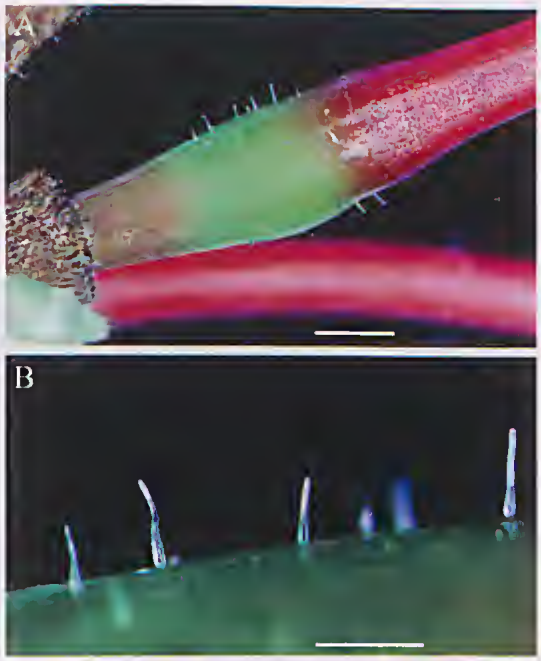

Figure 5. Ovary hairs in *G. victoriae* subsp. *brindabella*. Live material cultivated at Royal Botanic Gardens Melbourne (VS 2599). Scale bar = A. 1.0 mm; B. 0.5 mm (mag. A = 2 × 10; B = 11.5 × 10).

smaller flowers, the dorsal tepals being 16–19 mm long, whereas in the other two subspecies the dorsal tepals are 18.2–22(–23.5). It also has a smaller perianth limb (this character is related to tepal size), 2.2–2.5(–3) mm across in side-view, compared with 3–4 mm across in side-view in the other two subspecies. Also, while not a strong character the distance between flower pair scars (post-anthesis) at the middle of the floral rachis in subsp. *brindabella* is 0.7–2 mm, compared with (1–)2–3(–4.5) mm in the other two subspecies. Another difference between subsp. *brindabella* and the other two subspecies is the presence of minute glandular hairs on the floral rachis, the pedicels and the perianth outer surface in some plants (see Fig. 3). Unfortunately this is not a constant character, it is found in some plants and absent in other plants within the same population. Apart from *G. rhyolitica* subsp. *semivestita*, no other member of the 'Linearifolia group' (*sensu* Makinson 2000) is known to possess glandular hairs on the floral rachis. Another interesting character is the presence of hairs on the ovary of some plants within a particular population. At Waterfall Creek Falls the hairs are patent, simple, scattered, and silvery-

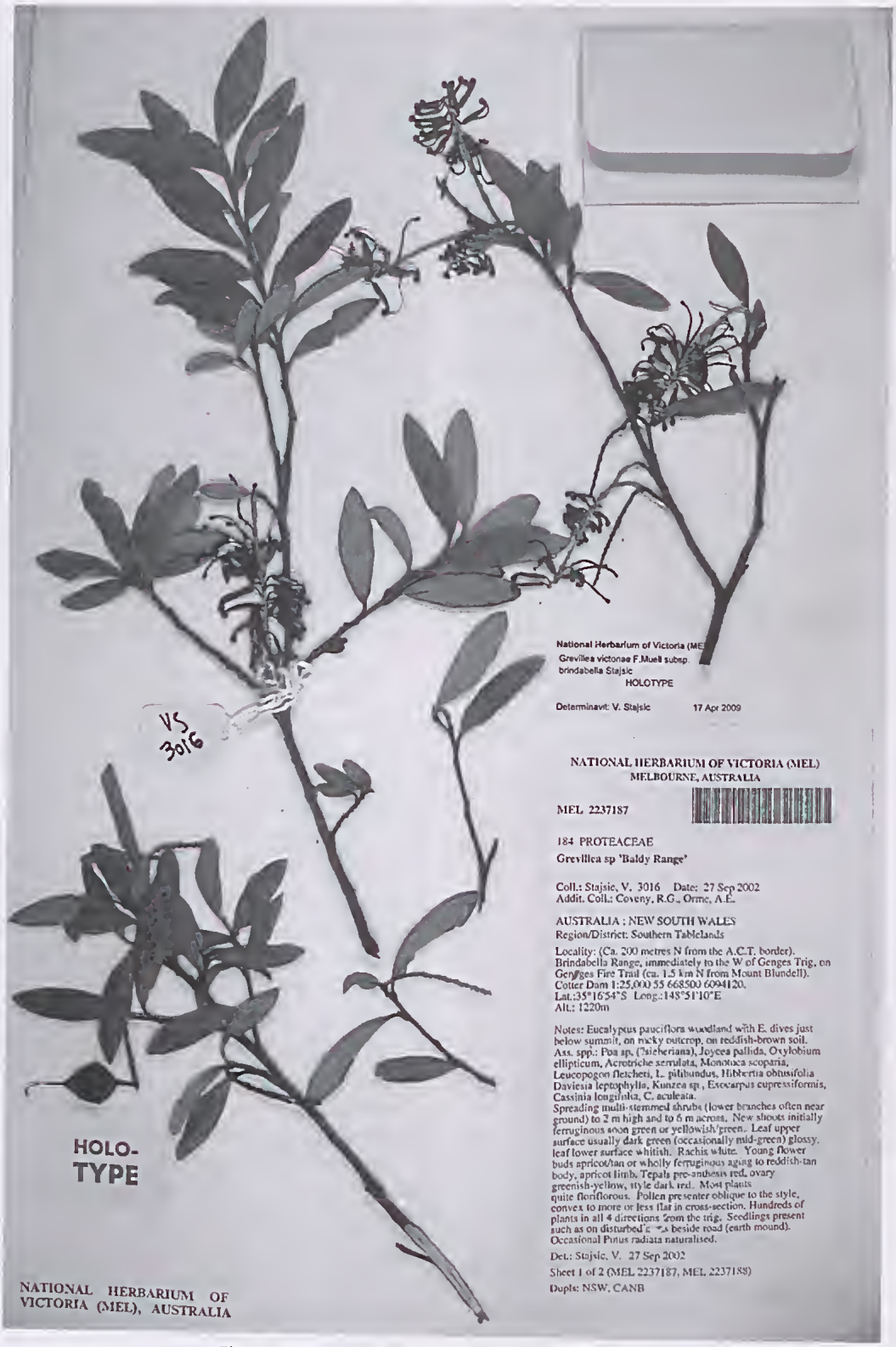
National Herbarium of Victoria (MEL)
Grevillea victoriae F.Muell subsp.
brindabella Stajsic
HOLOTYPE
Determinavit: V. Stajsic 17 Apr 2009
VS
3016
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2237187
184 PROTEACEAE
Grevillea sp 'Baldy Range'
Coll.: Stajsic, V. 3016 Date: 27 Sep 2002
Addit. Coll.: Coveny, R.G., Orme, A.E.
AUSTRALIA : NEW SOUTH WALES
Region/District: Southern Tablelands
Locality: (Ca. 200 metres N from the A.C.T. border).
Brindabella Range, immediately to the W of Genges Trig, on
Genges Fire Trail (ca. 1.5 km N from Mount Blundell).
Cotter Dam 1:25,000 55 668500 6094120.
Lat.:35°16'54"S Long.:148°51'10"E
Alt.: 1220m
Notes: Eucalyptus pauciflora woodland with E. dives just
below summit, on rocky outcrop, on reddish-brown soil.
Ass. spp.: Poa sp. (?sieberiana), Joycea pallida, Oxylobium
ellipticum, Acrotriche serrulata, Monotoca scoparia,
Leucopogon fletcheri, L. pilibundus, Hibbertia obtusifolia
Daviesia leptophylla, Kunzea sp., Exocarpus cupressiformis,
Cassinia longifolia, C. aculeata.
Spreading multi-stemmed shrubs (lower branches often near
ground) to 2 m high and to 6 m across. New shoots initially
ferruginous soon green or yellowish/green. Leaf upper
surface usually dark green (occasionally mid-green) glossy,
leaf lower surface whitish. Rachis white. Young flower
buds apricot/tan or wholly ferruginous aging to reddish-tan
body, apricot limb. Tepals pre-anthesis red, ovary
greenish-yellow, style dark red. Most plants
quite florifloruous. Pollen presenter oblique to the style,
convex to more or less flat in cross-section. Hundreds of
plants in all 4 directions from the trig. Seedlings present
such as on disturbed'e "s beside road (earth mound).
Occasional Pinus radiata naturalised.
Det.: Stajsic, V. 27 Sep 2002
Sheet 1 of 2 (MEL 2237187, MEL 2237188)
Dupls: NSW, CANB
HOLO-
TYPE
NATIONAL HERBARIUM OF
VICTORIA (MEL), AUSTRALIA

Figure 6. *G. victoriae* subsp. *brindabella* holotype (VS 3016).

Figure 7. *G. victariae* subsp. *brindabella*. Live material cultivated at Royal Botanic Gardens Melbourne (VS 2599). A. canflarescence; B. flawer. Scale bar = 5 mm.

white (see Fig. 4). On the other hand, plants from the Baldy Range Fire Trail population have longitudinally aligned, appressed, scattered biramous hairs. Only one hair type occurs within each population. Hairs on the ovary have not been observed in any other member of the 'Linearifolia group' (Makinson 2000).

Grevillea victoriae subsp. *brindabella* also differs from subsp. *victoriae* in usually having semi-glossy or distinctly glossy leaf upper surfaces (where in subsp. *victoriae*, the leaf upper surfaces are dull), a character shared with subsp. *nivalis* and *G. brevifolia*. The leaves in subsp. *brindabella* are usually smaller than in subsp. *victoriae*, with a usually lower leaf length to width ratio; and the floral rachises are usually shorter (see Table 1). The colour of very early flower buds in subsp. *brindabella* varies from wholly ferruginous, or the perianth-limb pale-ferruginous and the perianth below the limb more or less salmon-pink (whereas in subsp. *victoriae* the buds are wholly ferruginous, and in subspecies *nivalis* the buds are wholly ferruginous or pale-ferruginous).

Figure 8. Geagraphic distributian af *G. victoriae* subsp. *brindabella* (squares); *G. victariae* subsp. *nivalis* (triangles); *G. victoriae* subsp. *victoriae* (circles).

Table 1. A summary of the diagnostic characters for the subpecies of *Grevillea victariae* and *G. brevifalia*.

Character	Taxon			
	Grevillea victoriae subsp. ***victoriae***	***Grevillea victoriae*** subsp. ***nivalis***	***Grevillea victoriae*** subsp. ***brindabella***	***Grevillea brevifolia***
Branchlet indumentum	densely subsericeous	densely subsericeous or densely subtomentose	densely sericeous, or occasionally subsericeous	subsericeous to subtomentose
Leaf upper surface venation	lateral veins conspicuous; reticulum obscure or absent; reticulum absent	lateral veins conspicuous to prominent but occasionally variable on the same plant; reticulum usually evident, but varying from obscure to conspicuous on the same plant	lateral veins usually evident to prominent; reticulum absent	lateral veins obscure to evident; reticulum absent
Leaf upper surface glossiness	dull	usually semi-glossy	usually semi-glossy or distinctly glossy	usually semi-glossy
Leaf lower surface venation	lateral veins evident, or occasionally obscure; reticulum absent	lateral veins evident to conspicuous, occasionally prominent; reticulum conspicuous or occasionally prominent, rarely obscure or absent in some leaves	lateral veins obscure to evident; reticulum absent	lateral veins obscure to evident; reticulum absent
Leaf lower surface indumentum	usually densely sericeous or occasionally subsericeous, usually 'tidy', epidermis not visible	densely subsericeous or subtomentose, usually slightly 'messy', epidermis not visible	densely sericeous, usually 'tidy', epidermis not visible	densely sericeous or subsericeous, epidermis not visible
Leaf length × width	(30–)40–120(–200) mm × (8–)10–25(–50) mm	(20–)35–100(–135) mm × (7–)15–37 mm	(20–)40–60(–85) mm × (5–)12–18(–32) mm	(8–)21–38(–49) × 6–16 (–20)
Leaf length:width ratio	(2.85:1–)4:1–5:1(–6:1)	2.25:–4:1(–5:1)	(2:1–)2.5:1–3.5:1(–4:1)	(1.92:1–)2:1–2.5:1(–3.2:1)
Conflorescence branching	simple = 69% 1-branched = 20% 2-branched = 9% 3-branched = 2%	simple = 43.16% 1-branched. = 47% 2-branched = 7.84% 3-branched = 2 %	simple = 50 % 1-branched = 32% 2-branched = 18 %	simple = 77% 1-branched = 21% 2-branched = 2 %
Number of flowers per unit conflorescence	22–48(–60)	(16–)24–46(–68)	(20–)38–50(–64)	(14–)20–22(–30)
Perianth limb (shortly pre-anthesis) diameter in side-view	3–3.5 mm across	3–4 mm across	2.2–2.5(–3) mm across	2.8–3.2 mm across
Distance between flower pair scars (post anthesis) at middle of floral rachis	2.0–3(–4.5) mm	(1–)2–3(–4) mm	0.7–2 mm	0.7–2 mm

Floral rachis length	(17–)40–90 mm	(8–)10–50(–60) mm	(14–)25–50(–60) mm	(7–)15–20(–35) mm
Primary peduncles length × width	(0–)3–17 × 1.2–1.6 mm	(0–)3.5–13.5 × (–1.0–)1.3–1.5 mm	(0–)4–15 long × 1.2–1.5 mm	(0–)3–7(–11) × (1.0–)1.2–1.4(–1.8) mm
Colour of very early flower buds	wholly ferruginous	wholly ferruginous or pale ferruginous	wholly pale ferruginous, or perianth limb pale ferruginous and perianth below the limb ± salmon-pink	wholly ferruginous
Dorsal tepal length	18.2 –22 (–23.5) mm	16–19 mm	17.5–22 mm	
Perianth outer surface indumentum (below the limb)	moderately densely subsericeous, subtomentose or tomentose	moderately densely subtomentose or tomentose	moderately densely subsericeous	moderately densely subtomentose or tomentose
Glandular hairs	always absent	sometimes present	always absent	
Ovary hairs	always absent	sometimes present	always absent	

The perianth outer surface below the limb in subsp. *brindabella* is moderately densely subsericeous, whereas in subsp. *victoriae* it varies from moderately densely subsericeous to subtomentose to tomentose, and in subsp. *nivalis* it varies from moderately densely subtomentose or tomentose (see Fig. 5).

Grevillea victoriae subsp. *brindabella* differs from subsp. *nivalis* in that the branchlet indumentum is sericeous (whereas in subsp. *nivalis* the indumentum is subsericeous or subtomentose); the leaf upper surface reticulum is always absent (whereas in subsp. *nivalis*, the reticulum is obscure to conspicuous); the leaf lower surface lateral veins are obscure to evident, and the reticulum absent (whereas in subsp. *nivalis* the lateral veins are conspicuous to prominent, the reticulum is usually present, and conspicuous or prominent) (see Fig. 6); the leaf lower surface indumentum is sericeous and usually 'tidy', a character shared with subsp. *victoriae*, but not with subsp. *nivalis* which has a subsericeous to subtomentose to tomentose leaf lower surface indumentum (see Fig. 7).

Although of uncertain reliability, it has been observed that some plants in some of the populations of *G. victoriae* subsp. *brindabella* have leaf lamina that tend to be mainly broadly U-shaped or broadly V-shaped in cross-section, but the leaf cross-section can vary on the same plant, and includes leaves that are flat in cross-section. Further fieldwork is required to assess the usefulness of this character in relation to using it as an aid in differentiating between subsp. *brindabella* and the other two subspecies of *G. victoriae* and *G. brevifolia*.

The next most easily confused taxon with *G. victoriae* subsp. *brindabella* is *G. brevifolia*. *G. brevifolia* is distinguished from *G. victoriae* subsp. *brindabella* by its shorter, generally more obtuse leaves. The leaf upper surface lateral veins in *G. brevifolia* are obscure to evident, whereas in *G. victoriae* subsp. *brindabella* they are evident to prominent. The floral rachises are also shorter and fewer-flowered in *G. brevifolia*. The colour of very early flower buds is wholly ferruginous in *G. brevifolia*. The perianth outer surface indumentum (below the limb) is moderately densely subtomentose or tomentose in *G. brevifolia*, whereas in *G. victoriae* subsp. *brindabella* it is moderately densely subsericeous (see Fig. 8 for illustration of fresh material of *G. victoriae* subsp. *brindabella*). The

differences between the three subspecies of *G. victoriae* and *Grevillea brevifolia* are summarised in Table.

Acknowledgements

I am grateful to the Herbarium of New South Wales, which provided the *Grevillea* loan and partial financial support for fieldwork in 2002, and to Bob Coveny and Andrew Orme (both from NSW) for their very generous assistance with transport, and for their company during fieldwork. Also, thanks to Peter Wlodarczyk (Greybox and Grasslands Indigenous Nursery, Victoria) for assistance with transport and for his company during fieldwork. Thanks also to Peter Ollerenshaw (Bywong Nursery, Bywong, New South Wales) for providing cultivated specimens from the Baldy Range population. Thanks to my colleagues Helen Barnes (MEL) for photographing the holotype, Teresa Lebel (MEL) for assisting me with Photoshop, Alison Vaughan (MEL) for producing the distribution map, and Neville Walsh (MEL) for kindly writing the Latin diagnosis and for helpful comments on the paper. The two anonymous reviewers are thanked for their valuable comments on the paper.

References

Australian Plant Census (APC), IBIS database. Centre for Plant Biodiversity Research, Council of Heads of Australasian Herbaria. Accessed August 2009. <http://www.anbg.gov.au/chah/apc/>

Briggs, J.D. and Leigh, J.H. (1996). *Rare and Threatened Australian Plants*, rev. edn. CSIRO/Australian Nature Conservation Agency: Canberra.

IUCN (2001). *2001 IUCN Red List of Categories and Criteria*, ver. 3.1, International Union for Conservation of Nature and Natural Resources, Switzerland. Accessed 30 April 2009. <http://www.iucnredlist.org/static/categories_criteria_3_1>

McGillivray and Makinson (1993)

Makinson, R.O. (ed.) (2000). *Flora of Australia*, vol. 17A, *Proteaceae 2: Grevillea*. CSIRO Publishing: Collingwood.

Molyneux, W.M. and Stajsic, V. (2000). *Grevillea victoriae* subgroup (in part only). In R.O. Makinson (ed.), *Flora of Australia*, vol. 17A, *Proteaceae 2: Grevillea*, pp. 247–264. CSIRO Publishing: Collingwood.

Stajsic, V. and Molyneux, W.M. (2006). Taxonomic studies in the *Grevillea victoriae* F.Muell. species complex (Proteaceae: Grevilleoideae) I. Descriptions of nine previously segregated, and three new taxa. *Muelleria* **22**, 19–76.

A new species of *Leptostigma* (Rubiaceae: Coprosminae) and notes on the Coprosminae in Australia

a259430

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Introduction

Subtribe Coprosminae (Rubiaceae: tribe Anthospermeae) was erected by Fosberg (1982) to distinguish a relatively uniform morphological group placed among a broadly distributed and heterogeneous assemblage of genera. The Coprosminae has a trans-Pacific distribution, occuring in Australia, New Zealand, New Caledonia, Hawaii, Central America and South America. Its make-up has undergone several modifications since its erection, and is now thought to comprise five genera, *Coprosma* J.R.Forst. & G.Forst., *Durringtonia* R.J.Hend. & Guymer, *Leptostigma* Arn., *Nertera* Banks & Sol. ex Gaertn., and *Normandia* Hook.f. Fosberg (1982) indicated that the Coprosminae were distinguished from the remainder of the Anthospermeae by drupaceous fruits containing a pair, usually, of planoconvex pyrenes and a basal attachment of ovules. *Pomax* Sol. ex DC. and *Opercularia* Gaertn. are the two Australian genera in the Anthospermeae not included in the Coprosminae.

Although the greatest diversity in subtribe Coprosminae is outside of Australia, all genera with the exception of the New Caledonian endemic *Normandia* are represented in Australia by native species. Of the approximately 113 species in the subtribe, 14 occur in Australia. Twelve of these species are native and nine are endemic. New Zealand has approximately 57 species with most of these in *Coprosma*.

Anderson *et al.* (2001) assessed the phylogeny of the subtribe using nuclear (ITS) and chloroplast (rps16 intron) data and their results suggest that the current generic classification is satisfactory at least as it relates to genera in Australia. *Nertera* and *Coprosma* were shown to be sister taxa. *Durringtonia*, when first described was placed in a tribe of its own based on a suite of peculiar characters (Henderson & Guymer 1985). However, a reassessment of the morphology by Puff and Robbrecht (1988) and the molecular findings of Anderson *et al.* (2001) both indicate that this classification was inappropriate.

Recent taxonomic history: The number of native species recognised in Australia in what is now the Coprosminae was eight at the end of the

Abstract

A new species of *Leptostigmo* Arn. (Rubiaceae: Coprosminae), *L. breviflorum* I.Thomps., is described from Victoria, Australia and compared to *L. reptans* (F.Muell.) Fosberg. A key to Australian genera in the Coprosminae and a revised key to *Coprosma* J.R.Forst. & G.Forst. in Australia are presented. Distribution maps and nomenclatural information are presented for all species in the Coprosminae in Australia, including those in *Leptostigmo*, *Coprosmo*, *Nertero* Banks & Sol. ex Gaertn. and *Durringtonia* R.J.Hend. & Guymer. The occurrence of domatia in Australian *Coprosmo* is discussed, and *C. nivolis* W.R.B.Oliv. is recognised as occuring in Tasmania.

Keywords: taxonomy, Coprosminae, Anthospermeae, domatia.

Muellerio 28(1): 29-39 (2010)

Key to genera

1 Herbs with 4-angled stems; leaves sessile, with a bract-like, linear lamina < 1 mm wide; stigma solitary; pyrene solitary (coastal swamps) ..... ***4. Durringtonia***

1: Shrubs, trees or herbs with terete stems; leaves petiolate, with a green, elliptic-type lamina > 1 mm wide; stigmata 2 or more; pyrenes 2 or more 2

2 Fruit more or less dry and dull brown at maturity, with calyx lobes 2; plants hermaphrodite, hairy ..... ***1. Leptostigma***

2: Fruit succulent and brightly coloured at maturity, with calyx lobes absent or 4 or more; plants dioecious, or sometimes hermaphrodite but then plants glabrous 3

3 Shrubs, subshrubs or prostrate weakly woody herbs; petiole generally < 1/4 of length of lamina; plants dioecious or hermaphrodite; drupes variously coloured, mostly with calyx lobes evident; pyrenes 2–6 mm long ..... ***3. Coprosma***

3: Prostrate herbs; petiole ≥ 1/2 of length of lamina; plants hermaphrodite; drupes orange-red, lacking calyx lobes; pyrenes 1.5–2 mm long ..... ***2. Nertera***

nineteenth century. This number has now increased to 12 with the addition of new species, *Coprosma nivalis* W.R.B.Oliv. in 1935, *Durringtonia paludosa* R.J.Hend. and Guymer in 1985 and *C. niphophila* Orchard in 1986, and the recognition that *C. perpusilla* Colenso occurs in Australia as well as New Zealand (Orchard 1986). Two name changes have recently been made: *Nertera reptans* (F.Muell.) Benth. was recombined as *Leptostigma reptans* (F.Muell.) Fosberg (Fosberg 1982), and *N. granadensis* (Mutis ex L.f.) Druce has recently been recognised in Australia, replacing *N. depressa* Banks & Sol. ex Gaertn., following the prevailing view in South America that *N. granadensis* and *N. depressa* are synonymous (Andersson 1993). This topic is further discussed under *Nertera* below.

In preparing a *Flora of Australia* account of subtribe Coprosminae it was found that some aspects of the treatments of these species in recent state floras required revision. This paper has been written in order to communicate these revisions and, in particular, to describe a new species in *Leptostigma*.

Methods

Assessment of the taxonomy of the Coprosminae was based primarily on examination of herbarium material made available by AD, BRI, CANB, HO and MEL. Field collections were also made for a few species in *Coprosma* and *Leptostigma* to assist in understanding the morphology of the group. Examination of herbarium material from MEL and AD revealed several specimens of *Leptostigma* from south-central Victoria that did not conform to recent circumscriptions of *L. reptans* (e.g. in New South Wales and Victorian state floras; James 1992; Jeanes 1999) in terms of their much shorter flowers. This difference was subsequently correlated to differences in indumentum and leaf shape. Field examination of this short-flowered form at one site near Toolangi (*I.R.Thompson 1050*) indicated that floral size and general morphology was consistent within a population.

Taxonomy

Subtribe Coprosminae Fosberg, *Acta Phytotax. Geobot.* 33: 75 (1982)

Perennial herbs, weakly woody subshrubs, shrubs or small trees, hermaphrodite or dioecious. *Leaves* opposite; stipules interpetiolar, mostly collar-like or with apex somewhat deltoid, usually viscous-glandular or glandular-dentate*. *Flowers* with small or rudimentary calyx, with lobes absent, 2, 4 or 5, rarely more; stamens exserted, often greatly so; ovary inferior, 2-carpellate, functionally 1-carpellate in *Durringtonia*, carpels 1-ovulate; stigmata elongate and exserted, pilose. *Fruit* drupaceous, succulent, colourful, or more or less dry in *Leptostigma*; pyrenes 1–4 per fruit, most commonly 2.

* glandular teeth described by Orchard (1986) as denticles; by Gardner (1999) as colleters.

A subtribe of the Anthospermeae (Rubiaceae) comprising five genera and c. 113 species. Four genera and 14 species in Australia, including two introduced species of *Coprosma*. Puff also published a description of Coprosminae in 1982; however, it postdated that of Fosberg.

Key to species of *Leptostigma*

1 Corolla 7–12 mm long; anthers 1.8–3.0 mm long; ovary and fruit glabrous or nearly so; stem-hairs antrorse; leaf-lamina mostly with l:w ratio > 1.4 ..... **1. *L. reptans***

1: Corolla 3–4 mm long; anthers 0.8–1.3 mm long; ovary and fruit moderately hairy; stem hairs spreading; leaf-lamina mostly with l:w ratio < 1.4 ..... **2. *L. breviflorum***

Leptostigma Arn., *J. Bot. (Hooker)* 3: 270 (1841)

Perennial prostrate herbs, hermaphrodite. *Leaves* opposite, petiolate, entire, discolorous, without domatia; stipules forming a low collar, glandular-dentate, not connate with each other. *Flowers* solitary, terminal, protogynous, ±sessile; calyx 2-lobed or 4(–6)-lobed (not in Australia); corolla-tube generally elongate, predominantly 4-lobed; stamens becoming much exserted in male phase; anthers mostly rather large, without a terminal appendage; ovary inferior, 2-locular; style 2-fid from near base, with stigmata elongate, much exserted. *Fruit* pseudoaxillary, more or less dry, ellipsoid; pyrenes 2.

A genus of seven species from Central America, South America, New Zealand and Australia. In Australia perhaps most similar vegetatively to *Nertera* but with relatively shorter petioles, hairy stems and leaves, and glandular-dentate stipules. Species of *Leptostigma* in Australia and New Zealand are distinct in the genus in having a 2-lobed calyx. The chromosome number for *Leptostigma setulosum* (Hook.f.) Fosberg from New Zealand is n = 20 compared to n = 22 for *Coprosma* and *Nertera* (*fide* Gardner 1999). In Australian and New Zealand species at least, shoot development from one of the axils at the base of a terminal flower commences at anthesis and results in developing fruit being located well behind the growing points of the plant.

1. *Leptostigma reptans* (F.Muell.) Fosberg, *Acta Phytotax. Geobot.* 33: 82 (1982)

Diodia reptans F.Muell., *Trans. & Proc. Victorian Inst. Advancem. Sci.* 128 (1855); *Nertera reptans* (F.Muell.) Benth., *Fl. Austral.* 3: 431 (1867); *Coprosma reptans* (F.Muell.) F.Muell., *Fragm.* 9: 186 (1875)

***Type*:** Victoria. Snowy River, *F.Mueller*, i.1855; syn: MEL 2288169–2288172 (one indicating altitude of 2000' and so possibly in NSW, one indicating near coast and so near Orbost, Vic., the other two only specifying Snowy River).

Prostrate perennial herbs, rooting at nodes; older stolons to 1.5 mm diam. *Stems* with sparse to moderately dense indumentum of straight antrorse to subappressed hairs, mostly 0.3–0.8 mm long. *Leaves with* petiole 1–3 mm long; lamina ovate–broad-ovate, 5–17 mm long, 2–9 mm wide, l:w ratio mostly 1.4–2, drying pale to dark; base cuneate to truncate, occasionally cuneate; upper surface with sparse to scattered spreading hairs, 0.7–1.2 mm long, sometimes nearly glabrous especially medially. *Stipules* forming a low collar, with 1–3 glandular teeth, with erect hairs 1–2 mm long. *Flowers* sessile to subsessile; calyx lobes 2, triangular, 0.5–1 mm long, sometimes with additional minute glandular lobes, hairy; corolla finally 7–12 mm long, 1–1.6 mm wide at base of lobes (pressed), greenish-cream, usually tinged reddish; lobes 1–1.5 mm long, with margins red, usually with spreading hairs; stamens 4 (or 5), 25–35 mm long, filaments purple; anthers 1.8–3.0 mm long, 0.4–0.5 mm wide, cream, sometimes tinged purple; ovary nearly glabrous except at summit, stigmata to c. 15 mm long. *Fruit* short-pedicellate, broad-ellipsoid, 2–3 mm long excluding persistent calyx lobes, with longitudinal ribs, mostly nearly glabrous, sometimes with hairs in lines; pyrenes 2–2.5 mm long, 1.6 mm wide.

***Selected specimens of c. 40 examined*: SOUTH AUSTRALIA.** The Bluff, c. 4.5 km SW of Glencoe, *A.C. Beauglehole 6580 & D.N. Kraehenbuehl* (CANB); Honans Native Forest Reserve, *D.J. Duval 976 & others*, 21.xi.2007 (AD). **NEW SOUTH WALES.** Bombala R., c. 17 km NE of Bibbenluke, N of confluence with Back Creek, *I. Crawford 5894*, 29.xi.2000 (CANB, MEL 1005972, NSW). **VICTORIA.** Gorae West, *A.C. Beauglehole 366*, xi.1945 (MEL 1505764); Jancourt Forest [South] Rd, c. 8 km S of Purrumbete South, *D.E. Albrecht 5074*, 30.xi.1992 (AD, MEL 2017505); 17.5 km NE of Yarram PO, *A.C. Beauglehole 62515*, 14.xii.1978 (MEL 304525); sources of the Brodribb River, *E. Merrall*, xi.1887 (MEL 2267884). **TASMANIA.** summit of Strathgordon–Lake Pedder Rd, Humboldt Divide, *P.J. de Lange TAS113*, 16.iv.2000 (HO).

***Distribution and habitat*:** Occurs in far south-eastern South Australia, far south-eastern New South Wales, southern and eastern Victoria, and central Tasmania (Fig. 1). Grows in forests from low to montane altitudes.

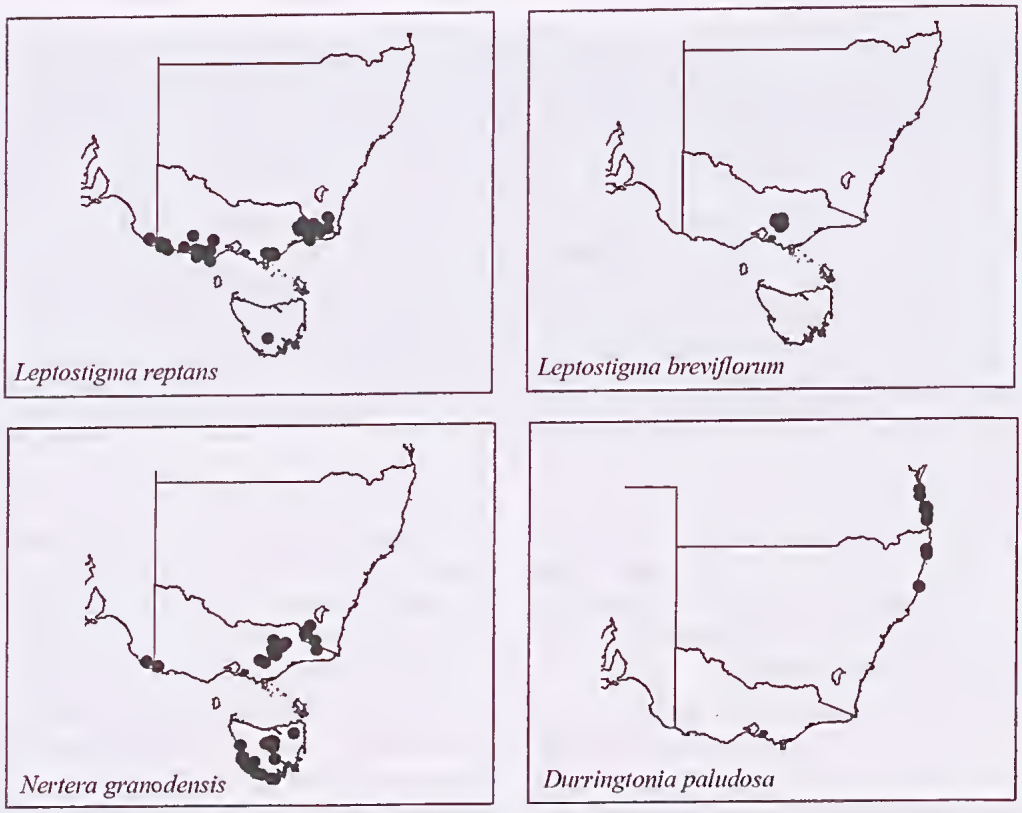

Figure 1. Distributions of *Leptostigmo reptans, L. breviflorum, Nertero gronodensis* and *Durringtonio poludoso*. The record of *L. reptons* in Tasmania is thought to be an introduction.

Flowering period: Flowers late spring to early summer.

Notes: *Leptostigma reptans* is protogynous and the corolla progressively elongates from male to female phases so the mature length of the corolla is unlikely to have been reached when only stigmata are exserted. Illustrations shown in Jeanes (1999) of *L. reptans* is likely to be this species rather than *L. breviflorum*. The caption for one of these illustrations stating 'male flower' is incorrect as flowers of this species are hermaphrodite. The flower is in the male phase; the stigmata are hidden within the corolla or lost.

2. *Leptostigma breviflorum* I.Thomps., *sp. nov.*

A L. reptanti (F.Muell.) *Fosberg foliis latioribus, pilis patentibus, floribus brevioribus, antheris minoribus, fructibus pilosis differt.*

Type: Victoria. Turnoff of Tanglefoot track from Sylvia Creek Rd, 6 km ENE of Toolangi, *K.R.Thiele 427*, 3.xii.1982; holo: MEL 304761.

Prostrate perennial herbs, rooting at nodes; older stolons becoming corky, to 1.5 mm diam. *Stems* with moderately dense indumentum of spreading hairs 0.5–1 mm long. *Leaves* with petiole 1–3(–5) mm long; lamina broad-ovate, 4–14 mm long, 3–13 mm wide, l:w ratio mostly 1–1.5, generally drying dark; base broad-cuneate to truncate; upper surface moderately hairy with spreading hairs 0.5–0.8 mm long. *Stipules* forming a low collar, with 3 glandular teeth, with spreading hairs 1–1.5 mm long. *Flowers* sessile; calyx lobes 2, triangular, 0.5–1 mm long, sometimes with additional minute glandular lobes, hairy; corolla 3–4 mm long, 1 mm wide at base of lobes (pressed), greenish externally with reddish tinges; lobes 0.7–1 mm long, with margins red, with spreading hairs; stamens 4, 5–8 mm long, filaments sometimes purple, anthers 0.8–1.3 mm long, c. 0.3 mm wide, usually purple; ovary covered in spreading hairs, stigmata 5–7 mm long. *Fruit* sessile, subglobose, 2–2.5 mm long excluding persistent calyx lobes, inconspicuously longitudinally ribbed, with scattered hairs; pyrenes 1.8–2.3 mm long, 1.8 mm wide (Figs 2 & 3).

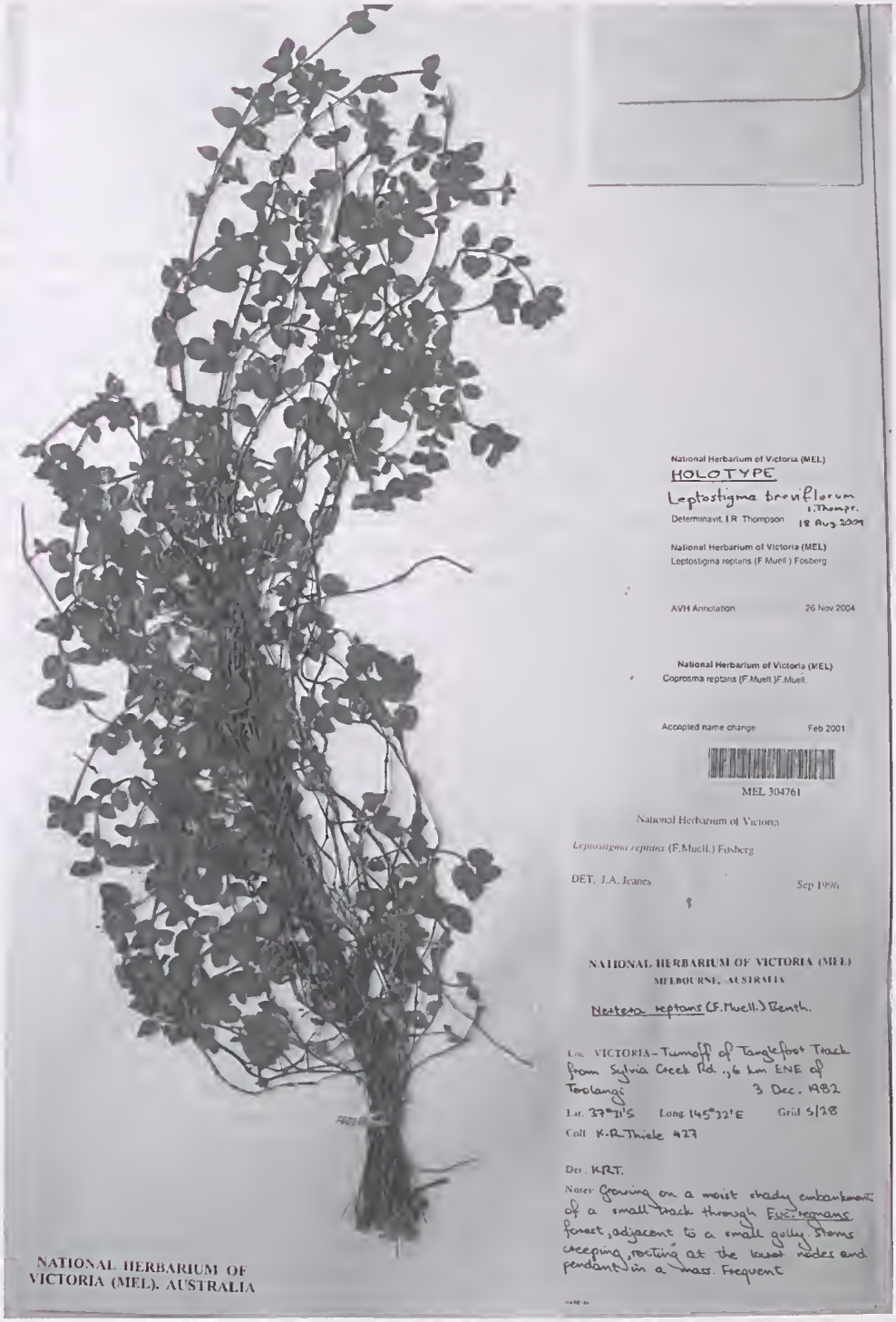
National Herbarium of Victoria (MEL)
HOLOTYPE
Leptostigma breviflorum
I.Thompr.
Determinavit I.R Thompson 18 Aug 2009
National Herbarium of Victoria (MEL)
Leptostigma reptans (F Muell.) Fosberg
AVH Annotation 26 Nov 2004
National Herbarium of Victoria (MEL)
Coprosma reptans (F.Muell.)F.Muell.
Accepted name change Feb 2001
MEL 304761
National Herbarium of Victoria
Leptostigma reptans (F.Muell.) Fosberg
DET. J.A. Jeanes Sep 1996
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
Nertera reptans (F.Muell.) Benth.
Loc. VICTORIA - Turnoff of Tanglefoot Track from Sylvia Creek Rd., 6 km ENE of Toolangi 3 Dec. 1982
Lat. 37°31'S Long 145°32'E Grid 5/28
Coll K.R.Thiele 427
Det. K.R.T.
Notes: Growing on a moist shady embankment of a small track through Eucalyptus forest, adjacent to a small gully. Stems creeping, rooting at the lower nodes and pendant in a mass. Frequent
NATIONAL HERBARIUM OF VICTORIA (MEL). AUSTRALIA

Figure 2. Holotype of *Leptostigma breviflorum* (*K.R.Thiele 427* MEL).

Figure 3. *Leptostigma breviflorum*, flowering shoot. Hairs similar to those on the corolla and calyx are also present on leaves, stipules and ovary, but are not shown here for the sake of clarity. Three glandular teeth are shown protruding from the margin of the stipular sheath. Scale bar = 2 mm.

***Selected specimens of nine examined*: VICTORIA.** Lake Mountain State Park, *A.C. Beauglehole 71665*, 23.xi.1982 (MEL 2070904); Smythe's Creek, 6 km ESE of Warburton, *J.H. Willis*, 15.v.1966 (MEL 226698S); against retaining wall of Upper Royston SEC dam, Central Highlands, *J.H. Willis*, S.v.1963 (MEL 267887); Upper Yarra Water Catchment, *A.C. Beauglehole 71659 & C.M. Beardsell*, 23.xi.1982 (MEL 207090S); Murrindindi State Forest, *A.C. Beauglehole 70717*, 10.viii.1982 (MEL 2070903); Hardy Creek Rd, 200 m S of intersection with Sylvia Creek Rd, Toolangi State Forest, c. 10 km NE of Toolangi, *I.R. Thompson 1050*, 15.xi.2008 (AD, 8RI, CAN8, HO, MEL, NSW); Near picnic area, Cumberland Falls, *H.Eichler 18949*, 23.i.1967 (AD).

***Distribution and habitat*:** Occurs in south-central Victoria to the north-east of Melbourne in an area bounded by Lake Mountain, Toolangi and Warburton (Fig. 1). Grows in wet sclerophyll forest and at margins of *Nothofagus cunninghamii* (Hook.) Oerst. rainforest.

***Flowering period*:** Flowers late spring and summer.

***Etymology*:** The epithet refers to the short flowers (L. *brevis*, short, and *flos*, flower).

***Notes*:** *Leptostigma breviflorum* is most closely related to *L. reptans* and *L. setulosum*, the latter from New Zealand, but is readily distinguished from these species by the flowers, which have a much shorter corolla and shorter stamens with smaller anthers. Apart from the differences in floral morphology, *L. breviflorum* differs from *L. reptans* in having spreading rather than antrorse hairs on stems, leaves with a slightly lower length:width ratio and which dry darker, and ovaries and fruits that are hairier and less distinctly ribbed. Compared to *L. setulosum* (*fide* Allan 1961 and Gardner 1999), *L. breviflorum* has shorter, weaker hairs on leaves, flowers and fruit.

Nertera Banks & Sol. ex Gaertn., *Fruct. Sem. Pl.* 1: 124 (1788), *nom. cons.*

A genus of c. 15 species from Central America, South America, New Zealand and Australia. *Nertera granadensis* is the only representative in Australia and it is also native to New Zealand, Central America and South America.

Nertera granadensis (Mutis ex L.f.) Druce, *Rep. Bot. Soc. Exch.* Club Brit. Isles 1916: 637 (1917)

Gomozia granadensis Mutis ex L.f., *Suppl. Pl.* 129 (1782); *Coprosma granadensis* (L.f.) Heads, *Candollea* 51: 388 (1996).

***Type*:** South America. Precise locality unknown, Columbia, Herb. Linn. *172.1*, *Mutis*; lecto: LINN, lectotypifier unknown but cited by D.H. Lorence, *Monogr. Syst. Bot. Missouri Bot. Gard.* 73: 104 (1999).

Nertera depressa Banks & Sol. ex Gaertn., *Fruct. Sem. Pl.* 1: 124 (1788). *Type*: South America. Success Bay, Tierra del Fuego, *Banks s.n.*, no date; holo: K *n.v.*

Australian and New Zealand material was originally referred to *N. depressa* the type of which is from far southern South America. A number of authors (e.g., Lawrence 1949, Andersson 1993) have concluded that American material of *N. depressa* is synonymous with *N. granadensis*. Extrapolating from this conclusion, the name *N. granadensis* has been introduced by authors of recent Australian state floras (James 1992; Jeanes 1999). In contrast, the name *N. depressa* appears to have been consistently maintained in New Zealand. Whether Australian and New Zealand material represents the same taxon as in America has not been critically evaluated in this study.

Nertera granadensis is illustrated in Jeanes (1999); however, the caption for the illustration is incorrect in stating 'male flower' as the flowers of this species are hermaphrodite. The distribution of *N. granadensis* in Australia is shown in Figure 1.

Coprosma J.R.Forst. & G.Forst., *Char. Gen. Pl.* 137 (1776)

A genus of c. 90 species from South America,

Australia, New Zealand, smaller islands of the Pacific Ocean and south-east Asia. The greatest diversity is in New Zealand. Ten species occur in Australia, eight of these are native, with six endemic. Of the ten species, eight are dioecious, *Coprosma moorei* is hermaphrodite, and *C. niphophila* has a variable sexual pattern with flowers structurally bisexual but functionally sometimes unisexual.

Domatia are a feature of leaves of *Coprosma*, particularly the larger-leaved species. They are small cavities in leaves which are open to the abaxial side of leaves and located in the axil formed by the midrib and secondary veins. They are sometimes bordered by cilia. On the upper surface they appear as blister-like elevations in fresh material. Treatments of *Coprosma* in recent state floras (James 1992; Jeanes 1999) do not give an accurate account of the occurrence of domatia in Australian species. Both introduced species, *C. repens* and *C. robusta*, consistently have several domatia, with those in the former species generally having a larger orifice. Sometimes in pressed specimens of *C. robusta* the orifice is not readily seen; however, a tuft of hairs usually identifies its presence. Of the native species, *C. hirtella* consistently has leaves with a few to several domatia, although they are often somewhat obscure in pressed specimens. In *C. quadrifida*, domatia are occasionally present in a proportion of leaves. As leaves of this species are small, only 1–3 domatia are likely on any one leaf. In fresh material of this species, the blister-like elevations on the upper surface are conspicuous.

Coprosma quadrifida appears to be most closely related to *C. nitida* and the two species have occasionally been confused. Both species are shrubs with pubescent branchlets, and often short, spine-tipped branchlets, with solitary flowers, and similar interpetiolar stipules. Branchlets supporting flowers and fruit become recurved in both species. The main distinguishing features are given in the key below in couplet 5. In addition, *C. quadrifida* can be distinguished from *C. nitida* by several further features including its shorter stipular sheath. The stipular sheath, which is formed by the fusion of the interpetiolar stipules, is c. 0.5 mm high adjacent to petioles in *C. quadrifida*, whereas it is generally c. 1 mm high in *C. nitida*. Domatia are occasionally developed in *C. quadrifida* but they have not been recorded in *C. nitida*. Furthermore, the spine-tipped branchlets *of C. quadrifida* are more slender, the leaf-apex is more acute, the calyx tube is better developed, and the fruit is smaller.

A reassessment of herbarium records has revealed that *C. nivalis* occurs in Tasmania. It has been collected from the eastern side of Lake Augusta (*R.W. Purdie 3534* CANB), and the banks of Liawenee Canal (*W.M. Curtis* HO).

Flowers and stipules of *C. pumila*, *C. nivalis*, *C. perpusilla* and *C. niphophila* are well illustrated in Orchard (1986). Most species of *Coprosma* are illustrated in Jeanes (1999). On this plate, distinctions between leaves of *C. quadrifida* and *C. nitida* are accurately depicted, as are the scabrosities and leaf-apex in *C. hirtella*, and the domatia in a leaf of *C. repens*. However, the illustration of a leaf of *C. robusta* implies that domatia are absent; this is unlikely to be the case as discussed above.

Hybrids between *C. quadrifida* and introduced species of *Coprosma* have been recorded from Melbourne and the Mornington Peninsula in south-central Victoria. Collections from adjacent the Mt Tomah Botanic Gardens in the Blue Mountains, New South Wales (*C.H. Barker 12* and *29* MEL) are possibly also hybrids involving *C. quadrifida*. Possible second parents include *C. hirtella*, *C. repens* or *C. robusta*.

Native species

Species are listed alphabetically. Distributions of the eight native species are presented in Figures 4 and 5.

1. *Coprosma hirtella* Labill., *Nov. Holl. Pl.* 1: 70 (1805)

Type: Tasmania. Locality unknown, icono: *Nov. Holl. Pl.* 1: tab. 95 (1805)

2. *Coprosma moorei Rodway, Pap. & Proc. Roy. Soc. Tasmania 1893:* 179 (1894)

Type: Tasmania. Mount Arthur, *L.Rodway*, 3.iv.1893; syn: MEL 54909; near Mount Tyndall, *J.B. Moore*, 1891; syn: MEL 54908; Snake Plains, Mount Wellington, *L. Rodway*, 1892; syn: MEL 654170.

3. *Coprosma niphophila* Orchard, *Brunonia* 9: 134–135 (1986)

Type: New South Wales. Upper Blue Lake Cirque,

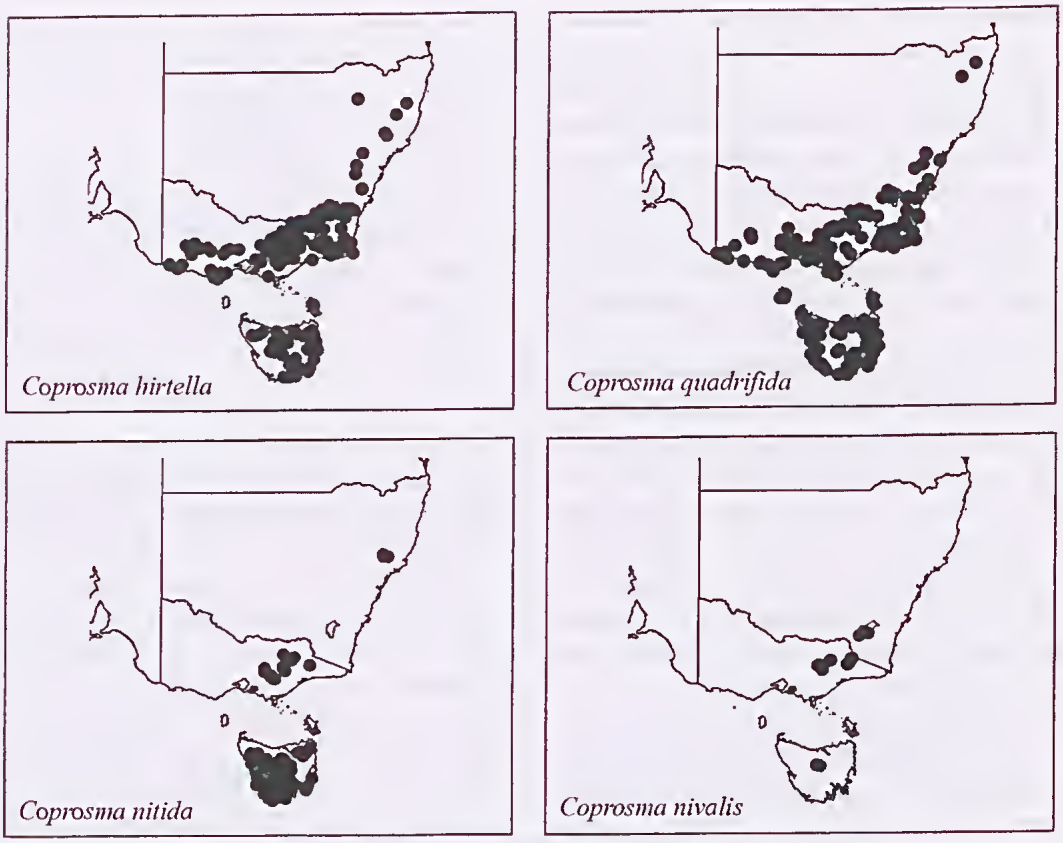

Figure 4. Distributions of *Coprosma hirtella*, *C. quadrifida*, *C. nitida* and *C. nivalis*.

Mt Kosciuszko Area, *M. Gray & C. Totterdell 6158*, 7.ii.1968; holo: CANB; iso: CANB.

4. *Coprosma nitida* Hook.f. in W.J.Hooker, *London J. Bot.* 6: 465 (1847), bis

***Type*:** Tasmania. Surrey Hills, *R.C. Gunn 874*, ii.1837; lecto: K, *fide* W.R.B. Oliver, *Bernice P. Bishop Mus. Bull.* 132: 57 (1935)

5. *Coprosma nivalis* W.R.B.Oliv., *Bull. Bernice P. Bishop Mus.* 132: 37 (1935)

***Type*:** Victoria. The Cobberas, Snowy Plains, *F. Mueller, s.d.*; holo: MEL 54916.

6. *Coprosma perpusilla* Colenso, *Trans. New Zealand Inst.* 22: 466 (1890)

***Type*:** New Zealand. River Wangaehu, near east base of Mount Tongariro, County of East Taupo, *H. Hill*, 1889; holo: WELT *n.v.*, *fide* A.E. Orchard, *Brunonia* 9: 131 (1986).

6a. *C. perpusilla* subsp. *perpusilla*

6b. *C. perpusilla* subsp. *subantarctica* Orchard, *Brunonia* 9: 133 (1986)

C. repens Hook.f., *Fl. Antarct.* 1: 22 (1844). [Macquarie Island is the only Australian locality]

***Type*:** New Zealand. Common Campbell's Island, *J.D. Hooker 1595, s.d.*; lecto: K, *fide* A.E. Orchard, *Brunonia* 9: 133 (1986).

7. *Coprosma pumila* Hook.f., *Fl. Antarct.* 2: 543 (1847)

***Type*:** Tasmania. Middlesex Plains, *R.C. Gunn 304*, ii.1837; syn: K, image seen MEL; near Arthurs Lakes, *R.C. Gunn 304*, 18.ii.1842; syn: K, image seen MEL.

8. *Coprosma quadrifida* (Labill.) B.L.Rob., *Proc. Amer. Acad. Arts* 45: 409 (1910)

Canthium quadrifidum Labill., *Nov. Holl. Pl.* 1: 69, t. 94 (1805); *Marquisia billardierei* A.Rich. ex DC., *Prodr.* 4: 447

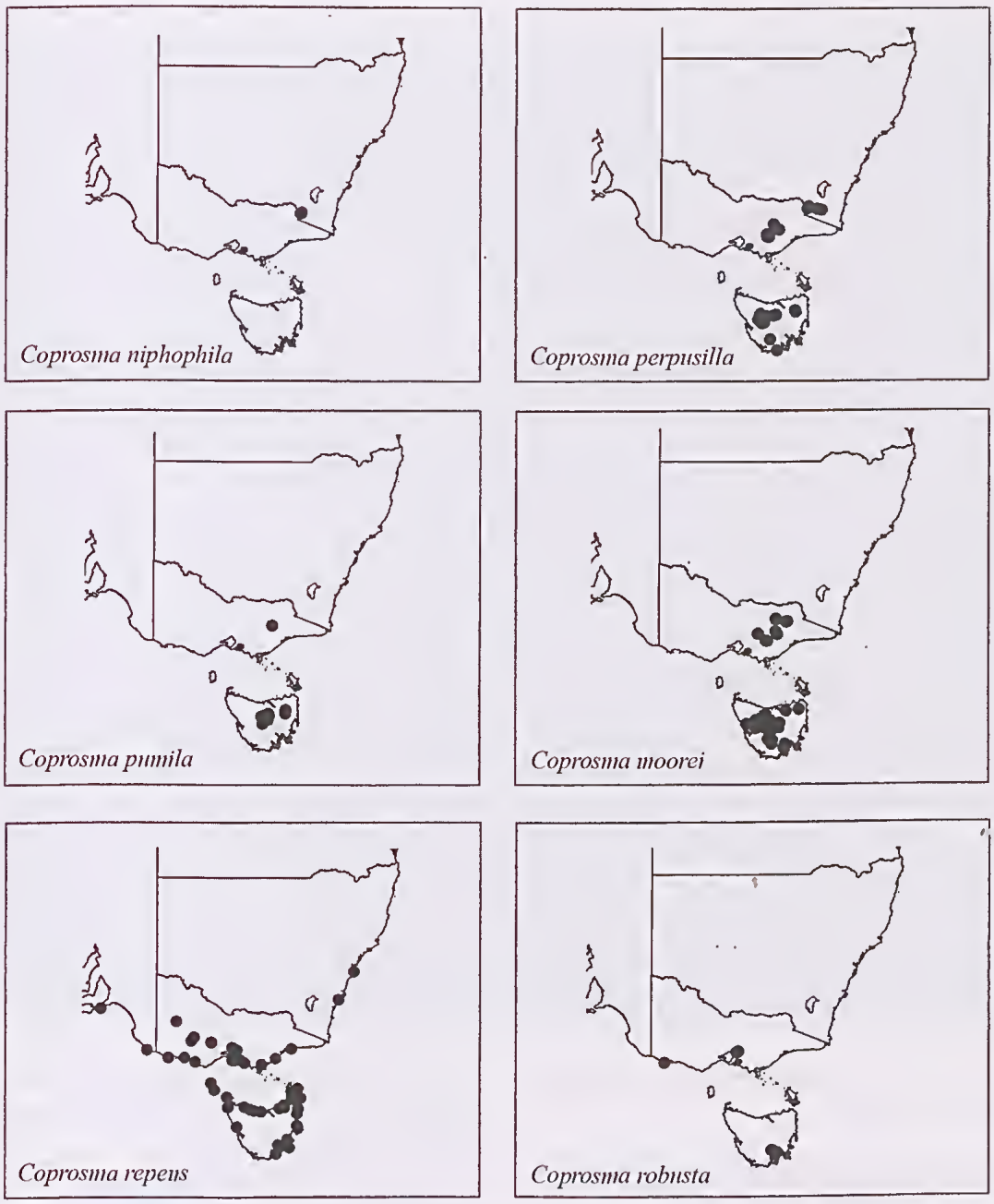

Figure 5. Distributions of *Coprosma niphophila*, *C. perpusilla* subsp. *perpusilla*, *C. pumila*, *C. moorei*, *C. repens* and *C. robusta*.

(1830), *nom. illeg.*, as *Billardieri*; *Canthium billardierei* D.Dietr., *Syn. Pl.* 1: 779 (1839), *nom. illeg.*, as *Billardierii*; *Coprosma billardierei* (DC.) Hook.f., *in* W.J.Hooker, *London J. Bot.* 6: 465 (1847) bis, *nom. illeg.*, as *Billardieri*.

***Type*:** Tasmania. Locality unknown; icono: *op. cit.*, t. 94 (1805).

Introduced species

Distributions of the two introduced species are presented in Figure 5.

A. *Coprosma repens* A.Rich., *in* J.S.C.Dumont d'Urville, *Voy. Astrolabe* 1: 264 (1832)

***Type*:** New Zealand. Astrolabe Harbour [Tasman

Key to species of *Coprosma*

Note: Microscopic examination will be necessary to identify domatia in most instances.

1 Flowers clustered; broadest leaves > 8 mm wide, domatia present (erect shrubs or small trees) 2

1: Flowers solitary; leaves < 7 mm wide, domatia absent, or occasional in *C. quadrifida* 4

2 Leaf apex conspicuously acuminate, apiculate; leaves commonly scabridulous above; calyx lobes > 0.5 mm long; stigmata > 10 mm long; drupes globose ..... *C. hirtella*

2: Leaf apex not or only gradually acuminate, not apiculate; leaves smooth above; calyx lobes not or hardly developed; stigmata < 10 mm long; drupes ellipsoid, broad-obovoid or sub-globose 3

3 Leaf apex broadly rounded to truncate; stipules with several denticles; drupes broad-obovoid to sub-globose ..... *C. repens*

3: Leaf apex subacute, acute or slightly acuminate; stipules with a single denticle; drupes ellipsoid ..... *C. robusta*

4 Erect or occasionally nearly prostrate shrubs; branchlets pubescent at first; short spine-tipped branchlets often present 5

4: Prostrate subshrubs; branchlets glabrous; spine-tipped branchlets absent 6

5 Leaves thin, margins flat to minutely recurved, secondary venation evident, petiole slender (width 1/6–1/12 of lamina-width); bracts subtending flowers 0.3–1 mm long; pyrenes 2–3 mm long ..... *C. quadrifida*

5: Leaves generally thickened, margins conspicuously recurved, secondary venation not evident, petiole stout (width 1/3–1/6 of lamina-width); bracts subtending flowers 1–3 mm long; pyrenes 3–5 mm long ..... *C. nitida*

6 Drupes deep blue; flowers bisexual; leaf apex acute and mostly with a minute point, margins minutely papillose ..... *C. moorei*

6: Drupes pale slaty blue, purplish-red or orange-red; flowers unisexual, or bisexual in *C. niphophila*; leaf apex rounded to acute without a minute point, margins not minutely papillose 7

7 Drupes pale slaty blue or purplish-red; at least some younger leaves with a few hairs on margins; l:w ratio of leaves commonly > 2.5 8

7: Drupes orange-red; leaves glabrous; l:w ratio of leaves mostly < 2.5 9

8 Drupes pale slaty blue; petiole < 20% of total leaf length; stipule margin ciliate; hairs absent from leaf apex ..... *C. nivalis*

8: Drupes purplish-red; petiole > 20% of total leaf length; stipule margin glabrous; a few hairs at leaf apex in at least a proportion of leaves ..... *C. pumila*

9 Flowers structurally unisexual; stigmata 3 or 4; pyrenes 3 or 4 per drupe; stipules < 0.8 mm long ..... *C. perpusilla*

9: Flowers structurally bisexual; stigmata 2; pyrenes 2 per drupe; stipules 0.8–1.1 mm long ..... *C. niphophila*

Bay], 1827, *A. Lesson*; holo: P *n.v.*, *fide* H.H. Allan, *Fl. New Zealand* 1: 584 (1961).

B. *Coprosma robusta* Raoul, *Ann. Sci. Nat., Bot. sér. 3, 2: 121 (1844)*

***Type*:** New Zealand. Akaroa, *coll. unknown*; holo: ?P *fide* H.H. Allan, *Fl. New Zealand* 1: 584 (1961).

Durringtonia R.J.Hend. & Guymer, *Kew Bull.* 40: 99–101 (1985)

A monotypic genus endemic in south-eastern Queensland and north-eastern New South Wales. Originally placed in a tribe of its own based on a suite of unusual features, including ovaries with a single functional carpel, but transferred to subtribe Coprosminae in tribe Anthospermeae by Puff and Robbrecht (1988).

Durringtonia paludosa R.J.Hend. & Guymer, *Kew Bull.* 40: 99–101 (1985)

***Type*:** QUEENSLAND. Eagers Swamp, behind the beach on the ocean (eastern) side, c. 6.5 km ENE of Tangalooma Tourist Resort, Moreton Island, *P. Sharpe 3260, G. Guymer & R. Henderson*, 17.xi.1982; holo: BRI; iso: CANB, NSW.

This species is illustrated in Henderson and Guymer (1985). Its distribution is presented in Figure 1.

Acknowledgements

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References

Allan, H.H. (1961). *Floro of New Zeolond*. R.E.Owen, Government Printer, Wellington.

Anderson, C.L., Rova, J.H.E. and Andersson, L. (2001). Molecular phylogeny of the tribe Anthospermeae (Rubiaceae): sstematic and biogeographic implications. *Austrolion Systemotic Botony* **14**, 231–244.

Andersson, L. (1993). Tribe Anthospermeae. In G. Harling and L. Andersson (eds), *Floro of Ecuodor*, vol. 47, pp. 11–17. Department of Systematic Botany, University of Goteborg and the Section for Botany, Riksmuseum: Stockholm.

Fosberg, F.R. (1982). A preliminary conspectus of the genus *Leptostigmo* (Rubiaceae). *Acto Phytotoxonomico et Geobotonico* **33**, 73–83.

Gardner, R.O. (1999). Systematic notes on *Leptostigmo setulosum* (Rubiaceae). *New Zeolond Noturol Sciences* **24**, 1–8.

Henderson, R.J.F. and Guymer, G.P. (1985). *Durringtonio* (Durringtonieae), a new genus and tribe of Rubiaceae from Australia, *Kew Bulletin* **40**, 97–107.

James, T.A. (1992). *Coprosmo*. In G.J. Harden (ed.), *Floro of New South Wales*, vol. 3, pp. 502–504. University of New South Wales Press Ltd: Sydney.

Jeanes, J.A. (1999). *Coprosmo*. In N.G. Walsh and T.J. Entwisle (eds), *Floro of Victorio*, vol. 4, pp. 636–641. Inkata Press: Melbourne.

Lawrence, G.H.M. (1949). Discussions in botanical names of cultivated plants. *Gentes Herborum* 8, 69.

Orchard, A.E. (1986). A revision of the *Coprosmo pumilo* (Rubiaceae) complex in Australia, New Zealand and the subantarctic islands. *Brunonio* **9**, 119–138.

Puff, C. (1982). The delimitation of the tribe Anthospermeae and its affinities to the Paederieae (Rubiaceae). *Botonicol Journol of the Linneon Society* **84**, 355–377.

Puff, C. and Robbrecht, E. (1988). The taxonomic position of the Australian endemic *Durringtonio* (Rubiaceae). *Austrolion Systemotic Botony* **1**, 191–197.

A revision of *Plagiocarpus* (Fabaceae: Brongniartieae)

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Abstract

A revision of the northern Australian genus *Plagiocarpus* Benth. (Fabaceae: Brongniartieae) is presented. Six new species are described in the formerly monotypic genus: *Plagiocarpus arcuatus* I.Thomps., *P. arnhemicus* I.Thomps., *P. conduplicatus* I.Thomps., *P. dispermus* I.Thomps., *P. lanatus* I.Thomps. and *P. longiflorus* I.Thomps. Distribution maps and an identification key are presented.

Keywords: taxonomy, Australia, tropical.

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Introduction

Plagiocarpus Benth. is a genus of small shrubs in the Fabaceae endemic to northern Australia. It is one of six Australian genera in tribe Brongniartieae, a tribe also represented by a few central and South American genera, including *Brongniartia* Kunth. *Plagiocarpus axillaris* Benth. is the only species ever described in *Plagiocarpus*. The genus is easily distinguished from other genera in the Brongniartieae by its sessile, digitately trifoliolate leaves, solitary, subsessile, yellow-petalled flowers and glabrous, subsessile, one- or two-ovulate ovaries.

The phylogeny of the Brongniartieae is not completely resolved. Recent phylogenetic studies include a morphological study by Crisp and Weston (1987), and a morphological and molecular study by Thompson *et al.* (2001), while data on plant alkaloids is presented in Ross (2001). Morphologically it appears that the six Australian genera form a natural group, with *Plagiocarpus* probably most closely related to *Lamprolobium* Benth., *Thinicola* J.H.Ross and *Cristonia* J.H.Ross based on aril and leaf morphology and the pale keel. On the other hand, the ellipsoid pods of *Plagiocarpus* are most similar to those of *Hovea* R.Br. and the leafless species of *Templetonia* R.Br.

Plagiocarpus occurs in far northern Australia, north of latitude 17° S, and from the Kimberley in Western Australia eastwards to Arnhem Land in the Northern Territory. The only exception to this distribution is a markedly disjunct record from far north-western Queensland. The distribution of the genus overlaps that of *Templetonia hookeri* (F.Muell.) Benth. and *Hovea arnhemica* J.H.Ross.

The only published taxonomic review of *Plagiocarpus* was one presented by Ross (1992) who considered, despite noting a moderate degree of morphological variation, that the genus should remain monotypic. In this paper, Ross also discussed an unpublished manuscript prepared by John Maconochie in the late 1970s in which a second species was proposed.

In the current study, the pattern of morphological variation elucidated by the author calls for the recognition of six new species. Of the seven species described below, three are endemic to Western Australia, three endemic to the Northern Territory, and one occurs in Western Australia, the Northern Territory and Queensland.

Methods

The pattern of morphological variation in the study group, as reflected in the taxonomy presented below, was determined through examination of herbarium material with the aid of a dissecting microscope. Assessment of floral morphology was aided by reconstituting dried material in hot water with detergent added. Specimens from AD, BRI, CANB, DNA, MEL and PERTH were examined.

Taxonomically useful characters recognised in this study include: plant stature; the distribution, orientation and density of hairs; the shape, width, degree of folding, shape of apex and length of apiculum of leaflets; the shape, size and indumentum of bracts and bracteoles; the shape and size of the calyx and petals; the width, beak robustness and seed number of pods; and aril morphology.

Taxonomy

Plagiocarpus Benth., *in* J.D.Hooker (ed.), *Icon. Pl.* 12: t. 1162 (1873)

Type: *P. axillaris* Benth.

Erect shrubs or *subshrubs*, 0.2–1(–2) m high, taprooted. *Indumentum* dense on younger branches, bracts, bracteoles and calyx, variably present and variably dense on leaves; hairs simple, straight, white to pale orangish, antrorse, appressed, divergent, or spreading. *Stems* single, or plants sometimes becoming multi-stemmed. *Leaves* apparently estipulate, alternate, mostly longer than internodes, sessile, digitately trifoliolate, usually suberect; leaflets all similar in length; petiolule c. 0.5 mm long, pulvinate; lamina with margins flat or recurved, with venation reticulate, slightly raised; apex apiculate, with apiculum mostly recurved; indumentum appressed, divergent or spreading, generally denser along margin and midrib; lateral leaflets narrow-elliptic, slightly asymmetrical, with lateral portion wider than medial, flat to concave proximally, flat or nearly so distally; medial leaflet slightly narrower than lateral leaflets, flat, concave, or folded, sometimes strongly so, sometimes conduplicate distally. *Inflorescences* axillary, of solitary flowers; pedicels to 1.5 mm long; bract and bracteoles small, generally slender; bract basal; bracteoles inserted c. at base of calyx. *Calyx* with tube slightly to moderately shorter than lobes, glabrous internally, generally persistent in fruit; calyx lobes generally similar, with apices acute; upper lobes more or less free, sometimes shorter and sometimes slightly broader than lower lobes, sometimes with apices divergent; petals all similar in length, clawed; standard and wings pale yellow; standard generally folded over other petals, mostly shallowly emarginate; wings auriculate, with an auricle lobe projecting downwards, keel not or hardly auriculate, pale, greenish at apex; stamens all fused to form a tube open adaxially; anthers dimorphic, alternately c. 0.8 mm long and basifixed, and c. 0.5 mm long and subdorsifixed and versatile; ovary short-stipitate, glabrous or rarely with isolated hairs on suture, 2-ovulate, style slender, stigma dilated or not. *Pods* short-stipitate, elliptic to oblong-elliptic or subcircular in profile, 9–13 mm long excluding beak, slightly gibbous dorsal to beak, slightly to moderately compressed, glabrous, sublustrous or lustrous, 1- or 2-seeded; vestigial ovules, when present, to c. 0.5 mm long. *Seeds* ellipsoid, plump or mildly compressed, 5–7 mm long, brown; hilum subapical, 0.5–1 mm long; aril annular, broad-elliptic or circular, wall smooth or somewhat knobbly, with a vertical lobe projecting from one side or towards apical end; orifice 0.2–0.7 mm wide.

Notes on morphology: LEAVES (Figs 1, 2 & 3). Although in this treatment leaves are described as compound, the lateral leaflets could reasonably be interpreted as leafy stipules as they have no connection with the medial leaflet, and they appear to insert at the same position as stipules do in other genera of the Brongniartieae. Lateral leaflets are asymmetrical with the lateral half of the lamina up to 20% wider than the medial half. The distinction is more obvious in broader-leafleted species (see Fig. 2a in particular). The species described below can be divided into a broad-leafleted group of five species and a narrow-leafleted group of two species.

FLOWERS (Figs 1, 4 & 5). Flowers are generally hidden by leaves in herbarium sheets; leaflets must be pulled back or removed to reveal them. The standard has only been seen in a folded state in pressed specimens, and field observations indicate that it seldom opens out to any great extent and probably only briefly under ideal conditions (M.D. Barrett pers. comm.). The standard

Figure 1. Original plate of *Plagiocarpus axillaris*. Source: Bentham (1876, plate 1162). Fruiting branches and drawings of flowers and fruit: 1. whole flower, including pedicel,bract and bracteole, 2. standard, 3. wing, 4*. keel, 5. stamen-tube with protruding style and stigma of pistil, 6. basifixed and dorsifixed anthers, 7. pistil, 8. pod and persistent calyx. Branches and pod approximately actual size. Flower parts 1–5 × 4; pistil × 6. *The number 4 is missing in the original.

Figure 2. Leaves and branchlets. a. *Plagiocarpus axillaris* (C.R. Michell 4147 DNA); b. *P. arnhemicus* (holotype); c. *P. longiflorus* (D.J. Dixon 1618 DNA); d. *P. dispermus* (*P. Foulkes* 327 PERTH). Scale bars all 5 mm.

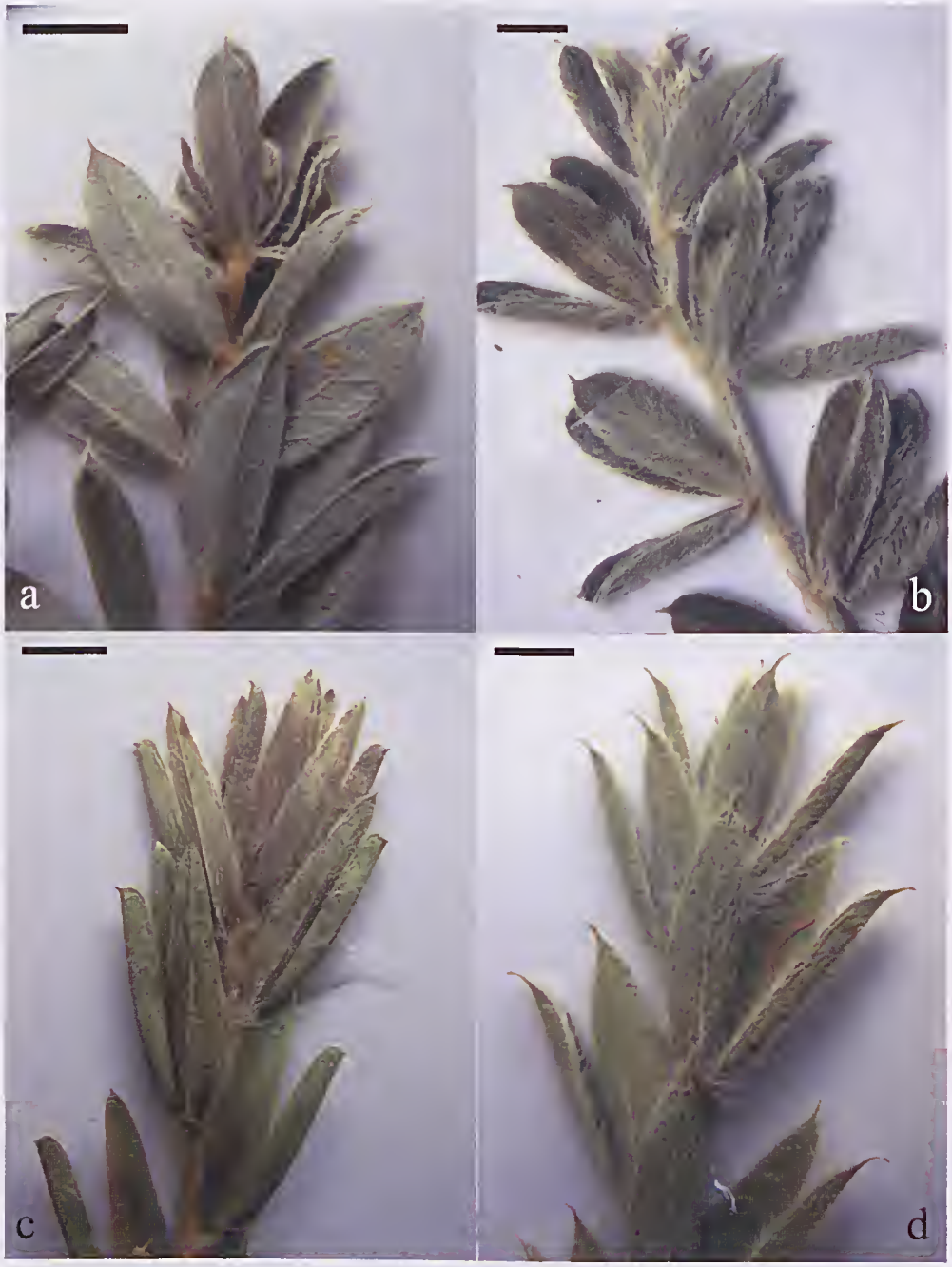

Figure 3. Leaves and branchlets. a. *Plagiocarpus dispermus* (grey-leaved form, *A.A. Mitchell 2416* PERTH); b. *P. lanatus* (holotype); c. *P. conduplicatus* (holotype); d. *P. arcuatus* (*S. King 134* DNA). Scale bars all 5 mm.

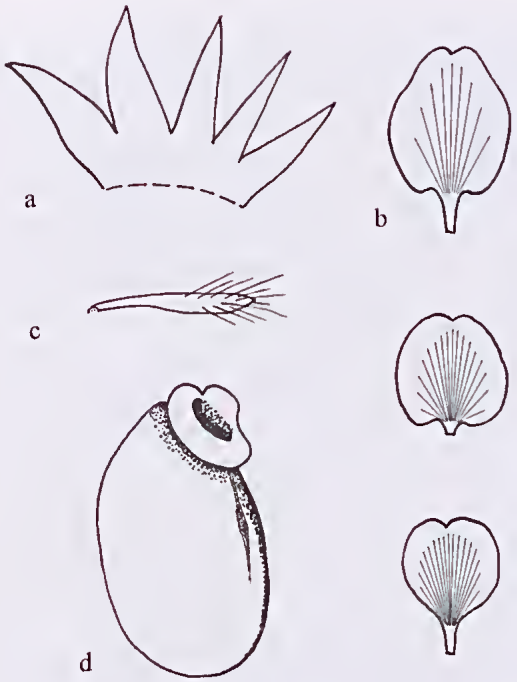

Figure 4. Flower parts and seed. a. Calyx opened out, upper lobes at left (generalised); b. Standard petals: top to bottom: *Plogiocorpus longiflorus* (C.R. Michell 2178 DNA), *P. lonotus* (holotype), *P. conduplicotus* (holotype); c. Bract of *P. conduplicotus* (side view showing one half of folded lamina); d. Seed (generalised). Scale: a × 4.5; b. × 2; c. × 10; d. × 6.

claw is sometimes geniculate (Fig. 5b). Wing petals have conspicuous transverse wrinkling proximally and lobed auricles. Their claw is shorter than that of the standard and keel petals. Keel petals lack auricles or auricles are rudimentary. Figure 4b shows the main variation in standard shape; species not represented have standards similar in general shape to those of *P. longiflorus*.

FRUIT (Figs 1 & 5). Measurements of the pod-beaks do not include the withered style that variably persists. Pod-valves change shape slightly at dehiscence, and are about 1 mm longer than pre-dehiscence. A comparison of post-dehiscence valves and beaks are presented in Figure 5d.

***Notes on the protologue*:** The genus *Plagiocarpus* and single species *P. axillaris* were described in part 3 of volume 12 of *Hooker's Icones Plantarum*, published as a separate part in December 1873. This publication has not been seen by the author; however, based on citations historically presented for the protologue, the text is presumed to be on unnumbered pages. A complete four-part volume was published in 1876, and in this publication the protologue is presented on pages 56 and 57 (Bentham 1876).

1. *Plagiocarpus axillaris* Benth., *in* J.D.Hooker (ed.), *Icon. Pl.* 12, part 3: t. 1162 (1873)

***Type*:** Northern Territory. Port Darwin, *F. Schultz 639*, 15.xi.1869; lecto: K, *fide* J.H. Ross, *Muelleria* 7: 422 (1992); iso: AD.

Subshrubs to c. 0.4 m high, becoming multi-stemmed from base. *Stems* 1–3 mm in diameter; young branches with a moderately dense, whitish to pale tan indumentum, with hairs 0.5–1 mm long, appressed or sometimes mildly divergent. *Leaflets* 14–22 mm long, with apex rounded to subacute; apiculum 0.1–0.5(–0.8) mm long, usually pale throughout, not or hardly exceeding adjacent hairs; indumentum sparse to scattered, with hairs 0.3–1 mm long, ± appressed; lateral leaflets asymmetrically elliptic, 4–8 mm wide; medial leaflet narrow-obovate or oblong-elliptic, 3.5–6 mm wide, flat or slightly concave. *Bract* 1–1.5 mm long, bracteoles 0.5–1 mm long. *Calyx* 3.5–4 mm long, including tube 1.5–1.8 mm long; upper lobes slightly broader than lower ones, with apices slightly divergent; standard c. 9 mm long, including claw 2 mm long, limb 6–7.5 mm wide, base cordate, apex rounded or shallowly emarginate; wings 8–9 mm long, including claw c. 1 mm long, limb 2.5 mm wide; keel 8–9 mm long, including claw 1.5 mm long, limb c. 3 mm wide; stigma hardly wider than style. *Pods* 10–11 mm long excluding beak, 5–6 mm wide, c. 4 mm deep, sub-lustrous, 1-seeded; beak mostly 1–2 mm long, c. 1 mm wide at base, ungrooved. *Seeds* 5 mm long, 3 mm wide, 3 mm deep; aril circular, 1.6–2 mm long, with wall smooth, aperture 0.5–0.7 mm long; lobe 0.3–0.6 mm high, 0.8–1 mm wide.

***Selected specimens of c. 20 examined*: NORTHERN TERRITORY.** Nitmiluk National Park, N boundary, *C.R. Michell 4147*, 8.iv.2002 (DNA); Port Keats, *G. Wightman 598 & C. Dunlop*, 11.viii.1983 (DNA); near Mt Greenwood, *S.T. Bloke 16564*, 23.vii.1946 (BRI, DNA); Moyle River, 70 km E of Port Keats, *P.K. Latz 13790*, 10.v.1994 (CANB, DNA, MEL 2092980, NSW, PERTH); Beside Allia Creek, c. 70 km S from Daly River Mission Settlement, Daly River Aboriginal Reserve, *N.G. Wolsh 3664*, 10.v.1994 (DNA, MEL 2020616); Cox Peninsular Road, *J.L. Egan 5480*, 17.i.2005 (CANB, DNA); headwaters of Cui-Eci Creek, *I. Cowie 4922 & D.E. Albrecht*, 12.v.1994 (DNA, MEL 724061).

Key to species

1 Broadest lateral leaflets ≤ 5 mm wide; medial leaflet usually moderately to strongly folded 2

1: Broadest lateral leaflets > 5 mm wide, or if narrower, then medial leaflet not moderately to strongly folded 3

2 Indumentum ± appressed; leaves glabrous or inconspicuously hairy; medial leaflet mostly obtuse to truncate (folded) with apiculum to c. 0.5 mm long ..... 6. *P. conduplicatus*

2: Indumentum ± spreading; leaves conspicuously hairy; medial leaflet acute (folded) with apiculum 0.6–1.5 mm long ..... 7. *P. arcuatus*

3 Claws of standard and keel petals 1–1.5 mm long; leaves lanate (fleecy) with surfaces much obscured ..... 5. *P. lanatus*

3: Claws of standard and keel petals 2–3 mm long; leaves sparsely-haired, or villous or sericeous-villous with surfaces not or only mildly obscured 4

4 Sub-shrubs to c. 0.4 m high; secondary stems/primary branches 1–2 mm diameter; apiculum mostly < 0.5 mm long; branch indumentum generally appressed; leaf hairs sparse to scattered, < 1 mm long ..... 1. *P. axillaris*

4: Shrubs mostly > 0.5 m high; primary branches mostly > 2 mm diameter; apiculum > 0.5 mm long; branch indumentum generally divergent; leaf hairs scattered to dense, 1–2 mm long 5

5 Upper lobes of calyx shorter than lower lobes; pods 7–9 mm wide, commonly 2-seeded (leaves commonly going dark on pressing; Western Australia) ..... 4. *P. dispermus*

5: Upper lobes of calyx as long as lower lobes; pods 5–7 mm wide, 1-seeded (leaves generally remaining green on pressing; Northern Territory) 6

6 Calyx 3.5 mm long; keel 7–8 mm long; leaflets moderately hairy (Arnhem Land) ..... 2. *P. arnhemicus*

6: Calyx 4.5 mm long; keel 10–11 mm long; leaflets rather densely hairy, sericeous (Victoria River area) ..... 3. *P. longiflorus*

***Distribution and habitat*:** Occurs in the far north-west of the Northern Territory (Fig. 6). Grows in sand on sandstone slopes in woodland and forest.

***Flowering period*:** Flowers at various times, mostly summer and autumn.

***Etymology*:** The epithet chosen by Bentham is presumed to refer to the axillary flowers in *Plagiocarpus* (From Latin, *axillaris*, axillary).

***Notes*:** A long stout taproot c. 1 cm in diameter is evident in a few specimens. The pods have a beak that is more robust than in other species and is ungrooved. In other species there is usually some evidence of a shallow groove on each side of the beak. The original plate of *P. axillaris* is reproduced in Figure 1 and leaf morphology is shown in Figure 2a.

2. *Plagiocarpus arnhemicus* I.Thomps., *sp. nov.*

A P. axillari Benth. planta robustiore, indumento villoso, apiculo foliolorum longiore, rostro leguminum graciliore, arillo sulcato basaliter plerumque differt.

***Type*:** Northern Territory. Arnhem Land, 19 km east of Jabiru, *R.W. Johnson 4625*, 19.iv.1989; holo: DNA; iso: AD, BRI, MEL 287026.

Shrubs 0.5–0.8 m high, with base of plant not seen. *Stems* to c. 5 mm diameter, major branches 2–4 mm diameter; young branches with a dense, pale orangish indumentum, with hairs 1–2 mm long, moderately divergent to almost spreading. *Leaflets* 13–22 mm long, with apex subacute to rounded; apiculum 0.8–1.5 mm long, pale throughout, sometimes exceeding adjacent hairs; indumentum sparse to moderately dense, with hairs 1–1.5 mm long, appressed or slightly divergent; lateral leaflets asymmetrically elliptic, 5–7 mm wide; medial leaflet narrow-obovate or oblong-elliptic, 4.5–6 mm wide, flat or slightly concave. *Bract* c. 1 mm long, bracteoles 0.5–1 mm long. *Calyx* 3.5 mm long, tube c. 1.5 mm long, upper lobes similar to lower ones, with apices hardly divergent; standard 9 mm long, including claw 2–2.5 mm long, limb 5.5–6.5 mm wide, base cordate, apex hardly emarginate; wings 7.5–8 mm long, including claw 1 mm long, limb 2–2.5 mm wide; keel 7.5 mm long, including claw c. 1.5 mm long, limb 2–2.5 mm wide; stigma hardly dilated. *Pods* 9–11 mm long excluding beak, 5–6 mm wide, c. 4 mm deep, sublustrous or lustrous, 1-seeded; beak 0.5–1 mm long, 0.5–0.7 mm wide at base. *Seeds* 5.5 mm long, 3.5 mm wide, 2–2.5 mm deep; aril slightly longer than wide, c. 2.5 mm long, wall smooth or partly fissured on top, commonly obscurely to conspicuously grooved basally,

Figure 5. Flowers and fruit a. Flower of *Plogiocorpus ornhemicus*, leaflet removed (*K. Brennon 1774* DNA); b. Petals of *P. longiflorus* (*C. Dunlop 8200* MEL); c. Undehisced pods of *P. dispermus*, grey-leaved form (*A.A. Mitchell 2416* PERTH); d. Dehisced pod valves, from left to right from top – *P. oxilloris* (*C.R. Michell 4147* DNA), *P. ornhemicus* (*C.R. Michell 210* DNA), *P. longiflorus* (*P.S. Short 5483* DNA), *P. dispermus* (*R.L. Borrett 1705* MEL), *P. conduplicotus* (*R.L. Borrett 4818* MEL), *P. orcuotus* (*J. Egon 2098* MEL); e. Pod of *P. dispermus* split open, revealing developing seeds (*R.L. Borrett 4876* MEL); f. Pod of *P. ornhemicus* split open showing persistent unfertilised ovule on one valve (*K. Brennon 1323* DNA). Scale bars all 5 mm.

aperture c. 1 mm long; lobe 0.5 mm high, c. 1 mm wide.

***Selected specimens of seven examined*: NORTHERN TERRITORY.** Upper East Alligator, Arnhem land, *C. Michell 210 & S. Knox*, 18.vi.1996 (DNA); Koongarra saddle, Kakadu National Park, *R.Thockwoy*, 16.v.1983 (CANB); Barramundi Gorge, *K. Brennon 1323*, 8.iv.1991 (DNA); Upper East Alligator River, *D.T. Liddle 1566 & Dempster*, 20.vi.1996 (DNA).

***Distribution and habitat*:** Occurs in Arnhem Land in the far north of the Northern Territory (Fig. 6). Grows on sandstone escarpments or slopes in eucalypt woodland or *Allosyncarpia* S.T.Blake forest or shrubland.

***Flowering period*:** Flowers summer and autumn.

***Etymology*:** The epithet refers to the fact that this species is endemic to Arnhem Land and is the only species of *Plagiocarpus* recorded for this region.

***Notes*:** Of the broader-leafleted species, *P. arnhemicus*

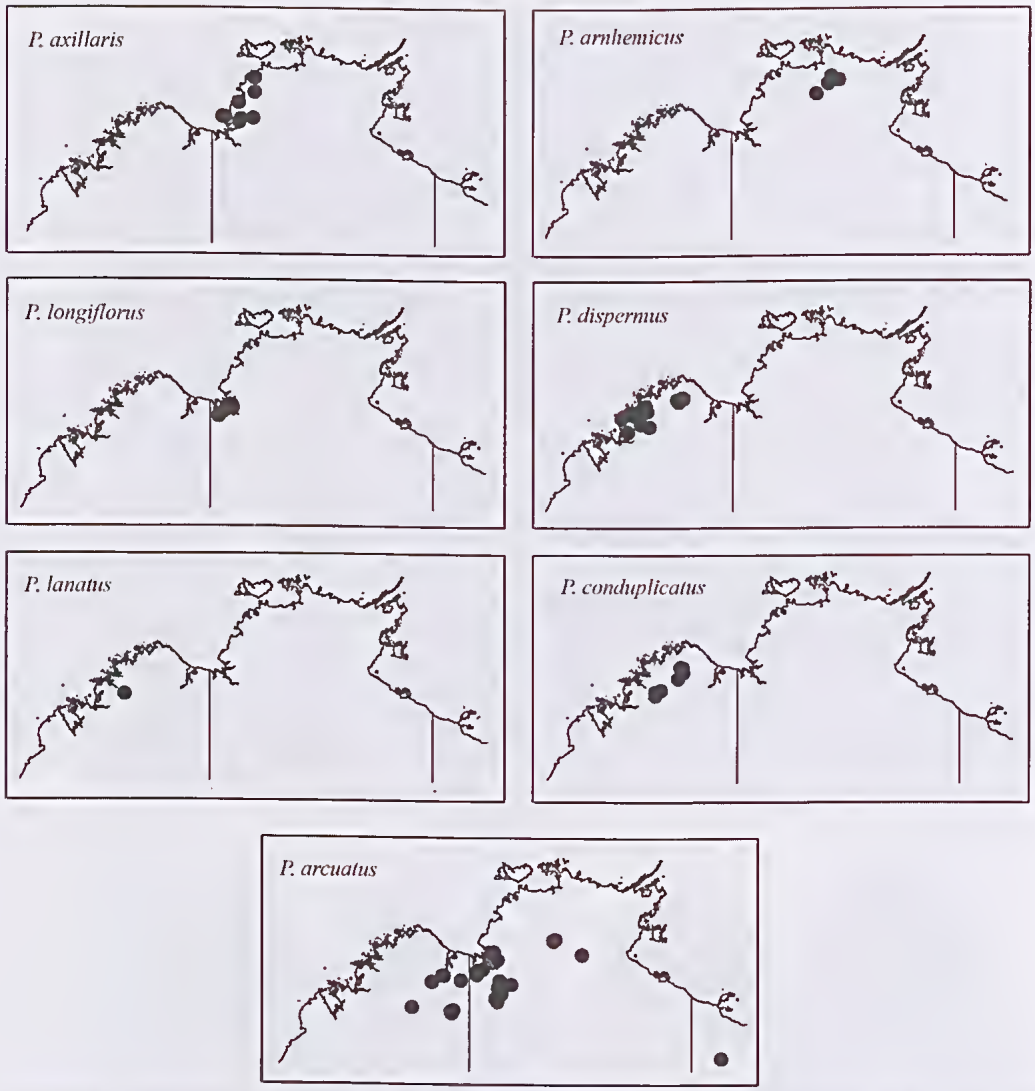

Figure 6. Distributions of *Plagiocarpus axillaris*, *P. arnhemicus*, *P. langiflorus*, *P. dispermus*, *P. lanatus*, *P. canduplicatus*, and *P. arcuatus*.

is the most similar to *P. axillaris* in terms of leaf indumentum. However, *P. arnhemicus* is a larger plant with a more divergent branch indumentum, longer apiculum and a more slender pod-beak. The aril of the seeds is often obscurely to conspicuously notched basally, a feature not seen in the aril of other species. The aril is rounded and smooth apically whereas in other species the apex is occasionally weakly indented. Leaves of *P. arnhemicus* are shown in Figure 4b and a flower *in situ* in a pressed specimen is shown in Figure 3a.

3. *Plagiocarpus longiflorus* I.Thomps., *sp. nov.*

A P. axillari *Benth. planta robustiore, indumento villoso, apiculo foliolorum longiore, floribus longioribus, rostro leguminum graciliore differt.*

***Type*:** Northern Territory. Spirit Hills Conservation Reserve, Victoria River district, *D.J. Dixon 1618*, 11.iii.2006; holo: DNA; iso: BRI.

Shrubs 0.4–1(–2) m high, with base of plant not seen. *Stems* not seen; major branches 2–4 mm diam; young branches with a dense, cream or orangish indumentum, with hairs 1.5–2 mm long, moderately divergent. *Leaflets* 16–26 mm long, with apex subacute to rounded; apiculum 0.5–1 mm long, pale throughout or tip becoming brown, brittle, not or hardly exceeding

adjacent hairs; indumentum dense, sericeous, with hairs 1–1.5 mm long, appressed or slightly divergent, generally divergent from margins; lateral leaflets asymmetrically elliptic, 5–8 mm wide; medial leaflet narrow-obovate or oblong-elliptic, 3–6 mm wide, mostly slightly to moderately concave or folded. *Bract* c. 1 mm long, bracteoles 0.5 mm long. *Calyx* 4.5–5 mm long, tube 1.5–2 mm long, upper lobes slightly wider than lower ones, with apices divergent; standard 10–12 mm long, including claw 3–3.5 mm long, geniculate, limb 7–8 mm wide, base slightly cordate, apex not or hardly emarginate; wings 10–11 mm long, including claw c. 1 mm long, limb 3.5 mm wide; keel 10–11 mm long, including claw c. 2 mm long, limb 3–3.5 mm wide; stigma hardly dilated. *Pods* 11 mm long excluding beak, 5–6 mm wide, 4 mm deep, sublustrous, 1-seeded; beak 0.8–1 mm long, c. 0.7 mm wide at base. *Seeds* 5.5–6 mm long, 4 mm wide, 3 mm deep; aril c. circular, 2 mm long, wall smooth, aperture c. 0.5 mm long; lobe 0.4–0.5 mm high, c. 0.8 mm wide.

***Selected specimens of c. seven examined*: NORTHERN TERRITORY.** Bradshaw Station, *C.R. Michell 2178*, 18.ii.1999 (DNA); c. 94 km NW of Timber Creek, *P.S. Short 5483 & J.O. Westaway*, 4.iv.2007 (DNA); Victoria River area, *C.R. Dunlop 8200 & G.J. Leach*, 9.v.1989 (BRI, DNA, MEL 222787).

***Distribution and habitat*:** Occurs in the Victoria River area in the far north-west of the Northern Territory (Fig. 6). Grows on sandstone escarpments or slopes in woodland, often with *Triodia* spp.

***Flowering period*:** Flowers spring to early autumn.

***Etymology*:** The epithet refers to the relative long flowers in this species (From Latin *longus*, long and *flos*, flower).

***Notes*:** *Plagiocarpus longiflorus* is one of the four species with both broad leaflets and a conspicuous leaf-indumentum. It is distinguished from the others by a combination of its long flowers, 1-seeded pods and the somewhat sericeous leaves (Fig. 2c). The corolla of this species is shown in its natural arrangement in Figure 5b.

4. *Plagiocarpus dispermus* I.Thomps., *sp. nov.*

A P. axillari *Benth. planta robustiore, indumento villoso plerumque, apiculo foliolorum longiore, leguminibus majoribus biseminalibus rostro graciliore differt.*

***Type*:** Western Australia. South side of Wulungi Chasm, Prince Regent River, *M.D. Barrett 965*, 29.i.2000; holo: PERTH.

[Remaining syntypes of *P. axillaris* collected from the Prince Regent River area of Western Australia (*A. Cunningham 192*, 1821 K and *A. Cunningham s.n.* K) are sterile specimens but are probably referable to *P. dispermus* based on general appearance and locality.]

Shrubs 0.4–1 m high, with base of plant not seen. *Stems* not seen; major branches mostly 2–4 mm in diameter; young branches with a dense, whitish or cream indumentum, with hairs 1–1.5 or occasionally 2–2.5 mm long, divergent, spreading or rarely appressed. *Leaflets* 14–25 mm long, with apex subacute to rounded; apiculum 0.5–1.5 mm long, pale throughout, usually shortly exceeding adjacent hairs; indumentum mostly moderately dense, with hairs loosely appressed, or spreading when hairs longer; lateral leaflets asymmetrically elliptic, mostly 5–8 mm wide; medial leaflet oblong-elliptic, elliptic or narrow-obovate, 4–6 mm wide, slightly to moderately concave or folded. *Bract* c. 1 mm long, bracteoles 0.5–1 mm long. *Calyx* c. 4 mm long, including tube c. 1.5 mm long, upper lobes slightly shorter than lower ones, with apices hardly divergent; standard 9–10.5 mm long, including claw 2.5 mm long, limb 8.5 mm wide, base slightly cordate, apex emarginate; wings 9–10 mm long, including claw 1–1.5 mm long, limb 3.5–4 mm wide; keel 9–10 mm long, including claw 2.5 mm long, limb 3–4 mm wide; stigma noticeably wider than style. *Pods* 12–13 mm long excluding beak, 7–9 mm wide, 6–7 mm deep, lustrous, 2-seeded; beak 0.5 mm long, 0.5 mm wide at base. *Seeds* 5.5 mm long, 3.5–4 mm wide, c. 3.5 mm deep; aril circular or very slightly longer than wide, c. 2 mm long, wall smooth, aperture c. 1 mm long; lobe 0.8 mm high, c. 1.2 mm wide.

***Selected specimens of c. 15 examined*: WESTERN AUSTRALIA.** Augustus Island, Bonaparte Archipelago, *P.G. Wilson 10809*, 16.v.1972 (PERTH); Junction of unnamed creek and Sale River, 30 km ESE of mouth, West Kimberley, *K.F. Kenneally 9597*, 13.v.1986 (PERTH); Planigale Creek, Drysdale River National Park, North Kimberley, *K.F. Kenneally 4450*, 19.viii.1975 (PERTH); 2 km SE of Wulungi Chasm on N side of Prince Regent River, *R.L. Barrett 1705 & M.D. Barrett*, 10.i.2001 (MEL, PERTH); c. 10 km S of King Cascade falls, Prince Regent River, *M.D. Barrett 724B*, 2.ii.1999 (PERTH); Peninsula NE of

Frederick Harbour at mouth of Hunter River, *P.A. Fryxell, L.A. Craven & J.McD. Stewart*, 8.vi.1985 (CANB); 5.2 km SW of junction of Pitta Creek and Prince Regent River, West Kimberley, *M.D. Barrett* 1839, 28.i.2007 (PERTH). **Grey-leaved form:** Hunter River, 300 m upstream from tidal-fresh water interface, 14°59'09"S, 125°29'14"E, *A.A. Mitchell & T. Willing 2416*, 10.iv.1992 (DNA, PERTH).

***Distribution and habitat*:** Occurs in the Kimberley in far north-eastern Western Australia (Fig. 6). Grows on sandstone escarpments or slopes in eucalypt woodland.

***Flowering period*:** Flowers January.

***Etymology*:** The epithet refers to the number of seeds commonly formed in each pod (From Greek, *di-* two and *sperma*, seed)

***Notes*:** Leaves of *P. dispermus* often turn dark, sometimes patchily, in the pressing process. This darkening is not seen in species of *Plagiocarpus* from the Northern Territory but is sometimes seen in *P. conduplicatus*. The circumscription of floral parts of *P. dispermus* is based on the very few available flowering specimens. Typical leaf morphology is shown in Figure 2d and pod morphology is shown in Figures 5d–e.

Several collections from the Prince Regent River region (e.g. *A.S. George 12630*, PERTH; *R.L. Barrett 3736*, PERTH) approach *P. arcuatus* in leaf morphology and indumentum type. However, flower, seed and fruit morphology, at least from the former collection, is the same as that of typical *P. dispermus*. It is uncertain whether the pods are two-seeded. The collections may represent a distinct taxon or they could be hybrid specimens, although *P. arcuatus* has not yet been recorded in this part of the Kimberley. They are treated as *P. dispermus* in this revision. Further collections are needed to properly ascertain the status of this form.

A grey-leaved form with an appressed indumentum has been collected from the mouth of the Hunter River (*A.A. Mitchell & T. Willing 2416*, DNA, PERTH). The greyness is not due to hairs as hairs are not particularly dense on the leaves (Fig. 3a). The specimen has particularly glossy pods (Fig. 5c) and pod and seed dimensions match those of typical *P. dispermus*. Flowering material in particular is needed to ascertain a suitable taxonomic status for this entity.

5. *Plagiocarpus lanatus* I.Thomps., *sp. nov.*

A P. axillari *Benth. indumento lanato, apiculo longiore, unguibus petalorum brevioribus differt.*

***Type*:** Western Australia. 17 km NW of Mount Hann, *M.D. Barrett 905*, 26.i.2000; holo: PERTH.

Shrubs to c. 0.7 m high, with base of plant not seen. *Stems* not seen; major branches 2 mm diam.; young branches with a dense white indumentum, with hairs c. 2 mm long, more or less spreading, matting together. *Leaflets* 15–23 mm long, with apex obtuse to subacute; apiculum 0.6–1 mm long, mostly brown, brittle, not or hardly exceeding adjacent hairs; indumentum very dense, with hairs c. 2 mm long, loosely appressed, hugging margins; lateral leaflets asymmetrically narrow-elliptic, 5–6.5 mm wide; medial leaflet oblong-elliptic or narrow-obovate, 4.5–5.5 mm wide, flat or slightly concave. *Bract* c. 1 mm long, bracteoles to c. 1 mm long. *Calyx* 3.5 mm long, with upper lobes similar to lower, with apices more or less straight; standard 7 mm long, including claw 1–1.5 mm long, limb c. 7 mm wide, base strongly cordate, apex broadly emarginate; wings 7–8 mm long, including claw 0.8–1 mm long, limb 3–3.5 mm wide; keel 6.5–7 mm long, including claw 1–1.3 mm long, limb 2.8 mm wide; ovary bearing a few long hairs on lower suture, stigma noticeably dilated. *Pods* not seen. *Seeds* not seen.

***Distribution and habitat*:** Occurs near Mount Hann in the western parts of the Kimberley in far north-eastern Western Australia (Fig. 6). Recorded from cracks in almost bare sandstone, associated with *Triodia* sp.

***Flowering period*:** Flowers January.

***Etymology*:** The epithet refers to the woolly or fleecy indumentum of this species (From Latin *lanatus*, woolly).

***Notes*:** Known from a single collection but readily distinguished from other species by both petal morphology (Fig. 4b) and indumentum type (Fig. 3b). Fruit and seeds have not been seen. *Plagiocarpus lanatus* occurs in the same general area of the Kimberley as *P. dispermus*. Although some forms of *P. dispermus* have hairs of similar length, the indumentum is villous rather than woolly or fleecy.

6. *Plagiocarpus conduplicatus* I.Thomps., *sp. nov.*

A P. axillari *Benth. planta robustiore, foliolis*

angustioribus, foliolo medio conduplicato plerumque truncato, floribus minoribus, rostro leguminum graciliore differt.

***Type*:** Western Australia. Above Carson Escarpment, *c.* 41 km south from Carson River homestead, *J.H. Willis*, 10.vi.1984; holo: MEL 239739.

Shrubs to 2 m high, single stemmed from base. *Stems and major branches* 2–4 mm diam.; young branches with a moderately dense, whitish indumentum, with hairs 0.5–1 mm long, appressed. *Leaflets* 12–20 mm long, with apex of lateral leaflets acute, that of medial leaflet obtuse, rounded or obliquely truncate (folded); apiculum 0.1–0.5 mm long, pale throughout or brown at tip, exceeding adjacent hairs; indumentum sparse with hairs *c.* 0.5 mm long, appressed, commonly soon glabrescent, lateral leaflets very narrow-elliptic or lanceolate, 2–3.5 mm wide; medial leaflet narrow-oblong, folded with halves appressed, at least distally, 1–1.8 mm wide. *Bract* 1.5–2 mm long, spathulate, strongly convex, tending to persist; bracteoles 1–1.5 mm long. *Calyx c.* 3.5 mm long, including tube 1.5 mm long, with all lobes similar; standard 7–7.5 mm long, including claw 2 mm long, limb *c.* 6 mm wide, base cuneate, apex broadly emarginate; wings *c.* 7 mm long, including claw 1.2 mm long, limb 2.5 mm wide; keel 6–6.5 mm long, including claw 1.5 mm wide, limb 2.5 mm wide; stigma a little wider than style. *Pods* 11–12 mm long excluding beak, 5–6 mm wide, 3.5–4.5 mm deep, 1-seeded; beak 0.2–1 mm long, *c.* 0.5 mm wide at base. *Seeds* 5.5–6.5 mm long, 3–4 mm wide, *c.* 2 mm deep; aril broad-elliptic, *c.* 2 mm long, wall smooth, aperture 0.8 mm long; lobe *c.* 0.7 mm high, *c.* 0.7 mm wide.

***Selected specimens of 10 examined*: WESTERN AUSTRALIA.** 9.9 km NE of Mt Agnes, West Kimberley, *R.L. Barrett 4065 & M.D. Barrett 4065*, 28.i.2007 (DNA, MEL, PERTH); Top of Carson Escarpment near Wonjarring Gorge, 12.5 km E of Theda Homestead, north-eastern Kimberley, *M. Lazarides 8718*, 25.iii.1978 (CANB, PERTH); Near summit of Mt Bomford, Drysdale River Station, *R.L. Barrett 1560 & M.D. Barrett*, 5.i.2001 (MEL 2290945, PERTH); Above gorge off upper Prince Regent River, 3.5 km NW of Mt Agnes, *M.D. Barrett 1141*, 9.i.2001 (MEL 2290944, PERTH); 6.2 km ENE of junction of Prince Regent River and Pitta Creek, *R.L. Barrett 1769 & M.D. Barrett*, 12.i.2001 (MEL 2290947, PERTH); Coucal Gorge, Carson Escarpment, Drysdale River National Park, *A.S. George 13861*, 15.viii.1975 (PERTH).

***Flowering period*:** Flowers autumn to early winter.

***Distribution and habitat*:** Occurs in the Kimberley in far north Western Australia (Fig. 6). Grows on sandstone plateaux.

***Etymology*:** The epithet refers to the medial leaflet (From Latin *conduplicatus*, folded together lengthwise).

***Notes*:** *Plagiocarpus conduplicatus* is readily distinguished by leaf morphology (Fig. 3c). It is also distinctive in the following respects. Its branches are all precisely oriented in one plane; in other species there is a similar tendency, but it is not as marked. Bracts and bracteoles are relatively large, and the oblanceolate to spathulate, proximally-glabrous, persistent bracts distinguish *P. conduplicatus* from all other species (Fig. 4c). In other species the bract is quite inconspicuous and covered in hairs. Only one flowering specimen of *P. conduplicatus* has been recorded, and in this specimen the standard-limb is cuneate in contrast to the slightly cordate limb in other species. The flower is also shorter than in most other species. *Plagiocarpus conduplicatus* and *P. dispermus* co-occur on Mt Bomford on Drysdale River Station (M.D. & R.L. Barrett, pers. comm.).

7. *Plagiocarpus arcuatus* I.Thomps., *sp. nov.*

A P. axillari *Benth. planta robustiore, indumento villoso, foliolis angustioribus plus recurvatis apiculo longiore, foliolo medio fortiter concavo, rostro leguminum graciliore, arillo granuloso differt.*

***Type*:** Western Australia. Cockburn Range, 46 km south-south-west of Wyndham, north-eastern Kimberley, *M. Lazarides 8578*, 16.iii.1978; holo: CANB; iso BRI, DNA, PERTH.

Shrubs 0.4–1 m high, with base of plant not seen. *Stems* to 5 mm in diameter; major branches 2–4 mm in diameter; young branches with a dense, whitish indumentum, with hairs 1.5–2 mm long, spreading. *Leaflets* 12–16 mm long, often recurved distally, with apex acute; apiculum 0.6–1.5 mm long, pale throughout or tip becoming brown, usually exceeding adjacent hairs; indumentum dense with hairs 1.5–2 mm long, divergent to spreading, occasionally glabrescent abaxially; lateral leaflets very narrow-elliptic or lanceolate, 3–5 mm wide; medial leaflet very narrow-elliptic, 2.5–3.5 mm wide, moderately convex to strongly folded, sometimes with halves appressed distally. *Bract* *c.* 1 mm long; bracteoles *c.* 1 mm long. *Calyx* 3–3.5 mm long, including tube 1–1.5 mm long, upper lobes

slightly broader than lower ones, with apices divergent; standard 8.5–10.5 mm long, including claw 2–2.5 mm long, limb 6–8 mm wide, c. truncate to slightly cordate, apex not or hardly emarginate; wings 9–10 mm long, including claw 1–1.5 mm long, limb 2.5–4 mm wide; keel 9–10 mm long, including claws c. 2 mm long, limb 2.5–3.8 mm wide; stigma hardly wider than style. *Pod* 9–10.5 mm long excluding beak, 5-6 mm wide, 4–5 mm deep, sublustrous to lustrous, 1-seeded; beak 0.5–1 mm long, 0.5–0.7 mm wide at base. *Seeds* 5.5–6.5 mm long, 3–4 mm wide, c. 3 mm deep; aril c. circular, 2–2.5 mm long, wall eroded on top, generally granular to knobbly, aperture 0.7 mm long; lobe 0.3–0.5 mm high, 0.6–0.9 mm wide.

***Selected specimens of c. 40 examined*: WESTERN AUSTRALIA.** Winnama Gorge, Mabel Downs station, SE Kimberley, *E.A. Chesterfield 212*, 14.v.19B4 (CANB, MEL 15344B4, PERTH); Osmond Valley Station, East Kimberley, *K.A. Menkhorst 694*, 25.xi.1989 (DNA, PERTH); Helicopter Spring, S Turkey Creek, *I.D. Cowie 1883*, 19.vii.1991 (DNA, PERTH); Mornington Wildlife Sanctuary, 250 km E of Derby, *S. Legge & S. Murphy 463*, 23.iv.2005 (CAN8); 20 km by road W of 8indoola creek, Kimberleys, *A.C. Beauglehole 51413*, 27.v.1976 (MEL 570516, PERTH). **NORTHERN TERRITORY.** c. 90 km E of Carlton Hills Station, *R.A. Perry 2642*, 2B.vii.1949 (DNA); Katherine Gorge lookout walk, *J. Egon 209B*, 1B.iv.1993 (DNA, MEL 7112B1); 8radshaw station, *C.R. Michell 2117 & C. Yates*, 20.ii.1999 (DNA); Headwaters of Pack Saddle Creek, Northern Carr Boyd Ranges, *T.G. Hortley 14404*, 8.iii.1978 (CANB, DNA, MEL 695B31); Fitzmaurice River, *M.J.A. Borritt 1406*, 15.v.1994 (8RI, DNA, MEL 725407); Keep River, National Park, Spirit Hills area, c. 21 km ENE of Ernie Lagoon, *I.D. Cowie 11727*, 19.iv.2007 (DNA, MEL 2316427); 11 km SW of Jasper Gorge Rd, *K.G. Brennon 4420*, 5.iv.2000 (DNA); 8roadarrow Creek, Gregory National Park, *D.E. Albrecht 722B*, 12.iv.1996 (DNA, MEL 283337); tributary of Snake Creek, 30 km WSW of 8ullita Outstation, Gregory National Park, *N.G. Walsh 4406 & C.A. Coles*, 16.iv.1996 (DNA, MEL 2032243). **QUEENSLAND.** 12 km S of Mellish Park homestead, *P.L. Horris 702*, 1B.ix.1993 (BRI, MEL 2343B4).

***Distribution and habitat*:** Occurs in far north-eastern Western Australia, northern Northern Territory and far north-western Queensland (Fig. 6). Grows on sandstone and quartzite mostly on escarpments, sometimes in valleys, in open woodland or open shrubland.

***Flowering period*:** Flowers summer.

***Etymology*:** The epithet refers to the arched leaflets (From Latin *arcuatus*, curved).

***Notes*:** This species has distinctive arcuate and long-apiculate leaflets and a distinctive villous indumentum (Fig. 3d). A few specimens from the Kimberley in Western Australia have leaves with a nearly glabrous abaxial surface (*A.C. Beauglehole 51413* MEL 570516, PERTH; *Cooper & Jensen MULE 463* PERTH) but the adaxial surface is villous. Western Australian plants (Cockburn Range *G.W.Carr 3367* MEL 570517) have flowers with broader and slightly longer petals than those from the Northern Territory. As discussed under *P. dispermus*, a few specimens from the Prince Regent River area of the Kimberley are somewhat intermediate between *P. arcuatus* and *P. dispermus* in leaf and indumentum characters. They have been assigned to *P. dispermus* but are possibly hybrids.

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References

Bentham, G. (1B76). *Plogiocorpus oxilloris*. In J.D.Hooker (ed.), *Hooker's Icones Plontorum*, vol. 12, pp. 56–57. Williams & Norgate: London.

Crisp, M.D. and Weston, P.H. (1987). Cladistic and legume systematics, with an analysis of the 8ossiaeeae, Brongniartieae and Mirbelieae. In C.H.Stirton (ed.), *Advonces in Legume Systemotics*, vol. 3, pp. 65–130. Royal Botanic Gardens, Kew: London.

Ross, J.H. (1992). A note on *Plogiocorpus* Benth. (Fabaceae: Brongniartieae). *Muellerio* **7**, 421–423.

Ross, J.H. (2001). Two new endemic Australian genera in the Tribe 8rongniartieae (Fabaceae) to accommodate two species formerly included in *Templetonio* R.8r. *Muellerio* **15**, 7–14.

Thompson, I.R., Ladiges, P.Y. and Ross, J.H. (2001). Phylogenetic Studies of the Tribe Brongniartieae (Fabaceae) using nuclear DNA (ITS-1) and Morphological data. *Systemotic Botony* **26**, 557–570.

A revision of the leafless species of *Templetonia* (Fabaceae: Brongniartieae)

a259432

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Introduction

Templetonia R.Br. is a genus of subshrubs and shrubs in tribe Brongniartieae (Fabaceae). It is one of six genera endemic in Australia in a tribe that also includes Central American and South American genera. *Templetonia*, as this study commenced, comprised ten species of which four, *T. egena* (F.Muell.) Benth., *T. battii* F.Muell., *T. sulcata* (Meisn.) Benth. and *T. smithiana* J.H.Ross appear to form a natural group based on several features, the most obvious being an apparent lack of leaves. The latter three actually develop a rudimentary leaf and pair of stipules at each node, while *T. egena* develops a scale. For the most part, these structures wither and fall. The group is also distinguished from leafy species of *Templetonia* by their relatively small flowers, short pedicels, brown-chartaceous bracts and bracteoles, and few-seeded, non-partitioned pods. All are much-branched shrubs growing to more than 1 m high and occur in semi-arid and arid parts of southern Australia, with only *T. egena* extending into northern Australia. The greatest diversity is in Western Australia and South Australia.

Templetonia is distinguished from other Australian genera in the Brongniartieae by the absence or sparseness of indumentum, broad bracts and bracteoles, and calyces with lower lobes imbricate in bud and with a tapering upper lip. The abundant reddish glandular material in leaf axils is also distinctive, although species of *Hovea* R.Br. and at least two American genera also develop these glands to some extent. In terms of calyx shape, *Templetonia* is most similar to the American genus *Brongniartia* Kunth. Although morphological data supports the monophyly of *Templetonia*, nuclear DNA data provides no support for a sister relationship between the leafless *T. egena* and a group of four leafy species (Thompson *et al.* 2001). Note that two additional species in the phylogenies presented in Thompson *et al.* (2001) and named as *Templetonia biloba* (Benth.) Polhill and *T. incana* have since been transferred to *Cristonia* J.H.Ross and *Thinicola* J.H.Ross respectively (Ross 2001).

Taxonomic history of leafless species: The first species described in the group was *Templetonia sulcata* in 1844, as *Bossiaea sulcata* Meisn. In the 1850s *Templetonia egena* was described; it was placed initially

Abstract

A revision of the leafless species of *Templetonia* R.Br. (Fabaceae: tribe Brongniartieae) is presented. Two new species are described, *T. incrassota* I.Thomps. and *T. ceroceo* I.Thomps. In addition, *Bossiaeo rossii* F.Muell. is resurrected and recombined as *Templetonio rossii* (F.Muell.) I.Thomps. Distribution maps and identification keys are presented.

Keywords: taxonomy, semi arid regions, Australia.

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in *Daviesia* Sm. and soon after in *Bossiaea* Vent. by Mueller. *Bossiaea rossii* was described in 1862. Bentham, in *Flora Australiensis*, transferred most of these taxa to *Templetonia*, but *Bossiaea rossii* F.Muell. was instead treated as a synonym of *Templetonia sulcata*. In 1887 *Templetonia battii* was described. Much later, a revision by Ross (1982) maintained the long-standing recognition of three species. However, soon after, Ross (1984) described *T. smithiana*, an entity he segregated from *T. sulcata*.

The need for a revision of the leafless species of *Templetonia* was identified while reviewing the tribe Brongniartieae for the *Flora of Australia* project. The pattern of morphological variation elucidated by the author in this study called for the number of leafless species of *Templetonia* to be increased from four to seven.

Methods

The pattern of morphological variation in the leafless group in *Templetonia*, as reflected in the taxonomy presented below, was determined through examination of herbarium material with the aid of a dissecting microscope. Assessment of floral morphology was aided by the reconstitution of dried flowers in hot water with added detergent. Specimens from AD, BRI, CANB, DNA, MEL and PERTH were examined.

Taxonomically useful characters recognised in this study include: the thickness, spinescence, degree of divergence, surface texture, waxiness, and depth of grooves of branches; the degree of development and persistence of rudimentary leaves; the presence of stipules; the length of pedicels; the scaliness and apical morphology of the bracteoles; the ovule number and length and stoutness of the style; the size and glandularity of pods; the size of seeds; and the size, lobation and dissection of the aril.

Taxonomy

Templetonia R.Br., *in* W.T.Aiton, *Hortus Kew.*, 4: 269 (1812)

***Type*:** *Templetonia retusa* (Vent.) R.Br.

The six leafy species of *Templetonia* develop either petiolate simple leaves with a green lamina more than 5 mm long and more than 1 mm wide, or they develop compound leaves with leaflets > 5 mm long. Other features which distinguish them from the leafless taxa include the longer flowers and pedicels, and the parallel-sided, more numerous-seeded, and mostly internally partitioned pods. *Templetonia aculeata* (F.Muell.) Benth. occasionally loses all of its leaves, but is recognised as a species in the leafy group by the features described above and by its conspicuous pungent stipules and its hairiness.

A circumscription of the leafless species of *Templetonia*

Shrubs to c. 3 m high, mostly as wide as or wider than high, generally much-branched, glabrous apart from ciliolate margins on bracts, bracteoles and calyces. *Branches* longitudinally ridged or angular, terete or flattened, sometimes slightly flexuose, sometimes tapering terminally and then sometimes spine-like; axils containing abundant reddish glandular material. *Leaves* rudimentary, developed at most nodes, most often withering and falling; stipules triangular, to c. 1 mm long, variably chartaceous, typically eroding to their base; a scale sometimes developed instead of a leaf and stipules. *Inflorescences* axillary, with flowering branches bearing flowers at several to numerous consecutive nodes, with 1 or 2 flowers per node, flowers opening ±simultaneously; bract basal, commonly brown, chartaceous; bracteoles inserted near base of calyx, often shortly connate, overlapping calyx tube, broad-ovate, orbicular or oblate, convex abaxially, herbaceous basally abruptly transitional to a chartaceous portion of varying extent, and which is predominantly brown but transparent distally. *Calyx* with tube equal to or longer than lobes; upper lip tapering; lower medial lobe the longest, straight or incurved, sometimes chartaceous distally; standard slightly longer than wings and keel, limb mostly cuneate, yellow with an inner purple-brown zone encircling a pale throat, wings with various proportions of purple-brown and yellow; keel pale throughout or purplish distally; stamens monadelphous, anthers dimorphic with dorsifixed anthers alternating with the longer basifixed anthers; ovary glabrous, 2–7-ovulate; style 2–4 mm long; stigma capitate. *Pods* almost spreading or more often suberect, short-stipitate, elliptic to oblong-elliptic in profile, 7–28 mm long, slightly to moderately

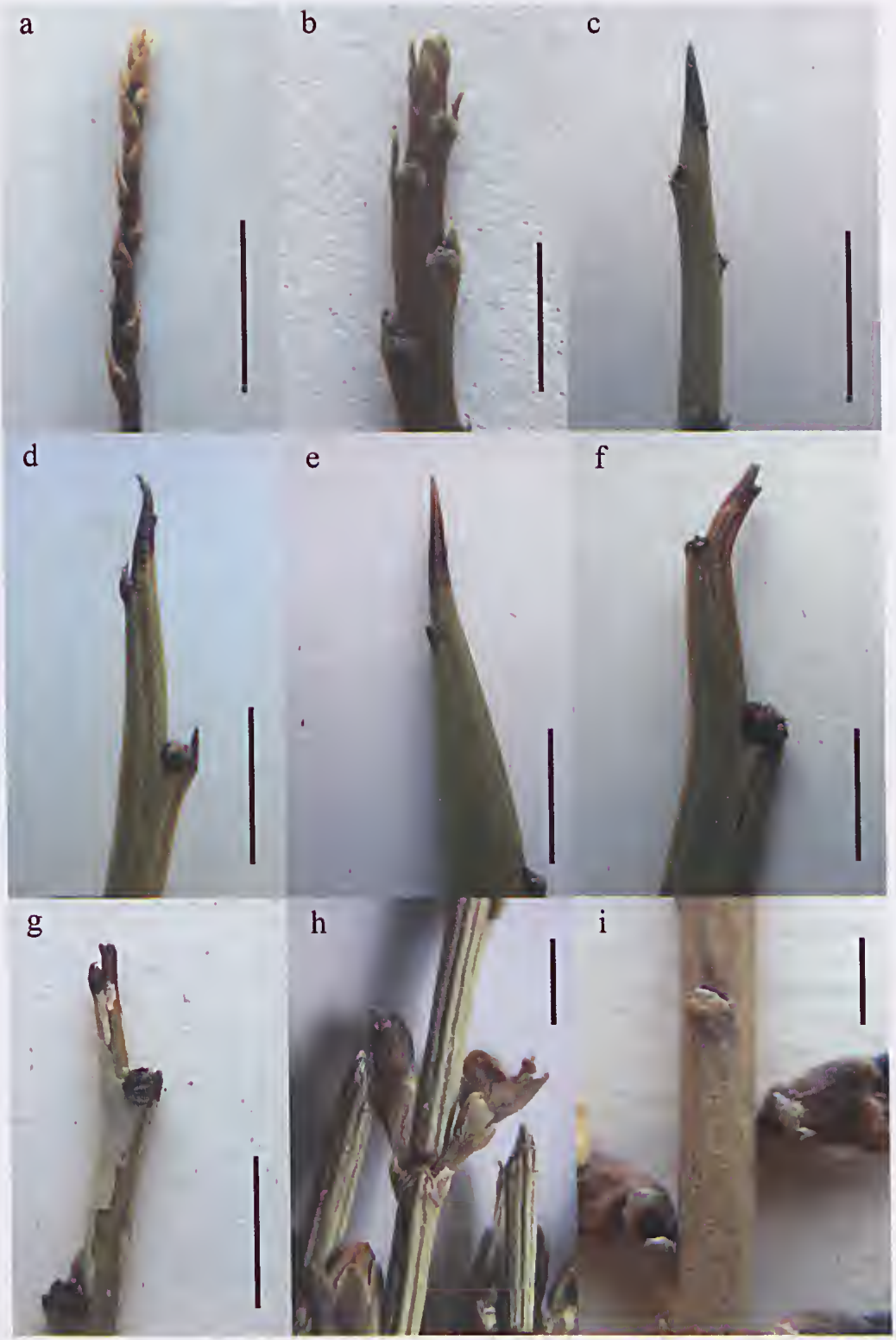

Figure 1. Branches. a–b. New growth. a. *Templetonia egena* (*J.G. Luehmann*, 1890 MEL); b. *T. rossii* (*B.Hadlow 565* CANB). c–g. Branch termini c. *T. battii* (*W.R. Archer 1009951* MEL); d. *T. sulcata* (*H. Eichler 15913* AD); e. *T. smithiana* (*A. Webb & B. Muir 272* PERTH); f. *T. rossii* (*E.N.S. Jackson 755* AD); g. *T. ceracea* (*M. Phillips* CANB 035493). h–i. Ridging. h. *T. egena* (*R.D. Royce 6588* PERTH); i. *T. incrassata* (*A.S. George 2718* PERTH). Scale bars: a–g = 5 mm; h–i = 2 mm.

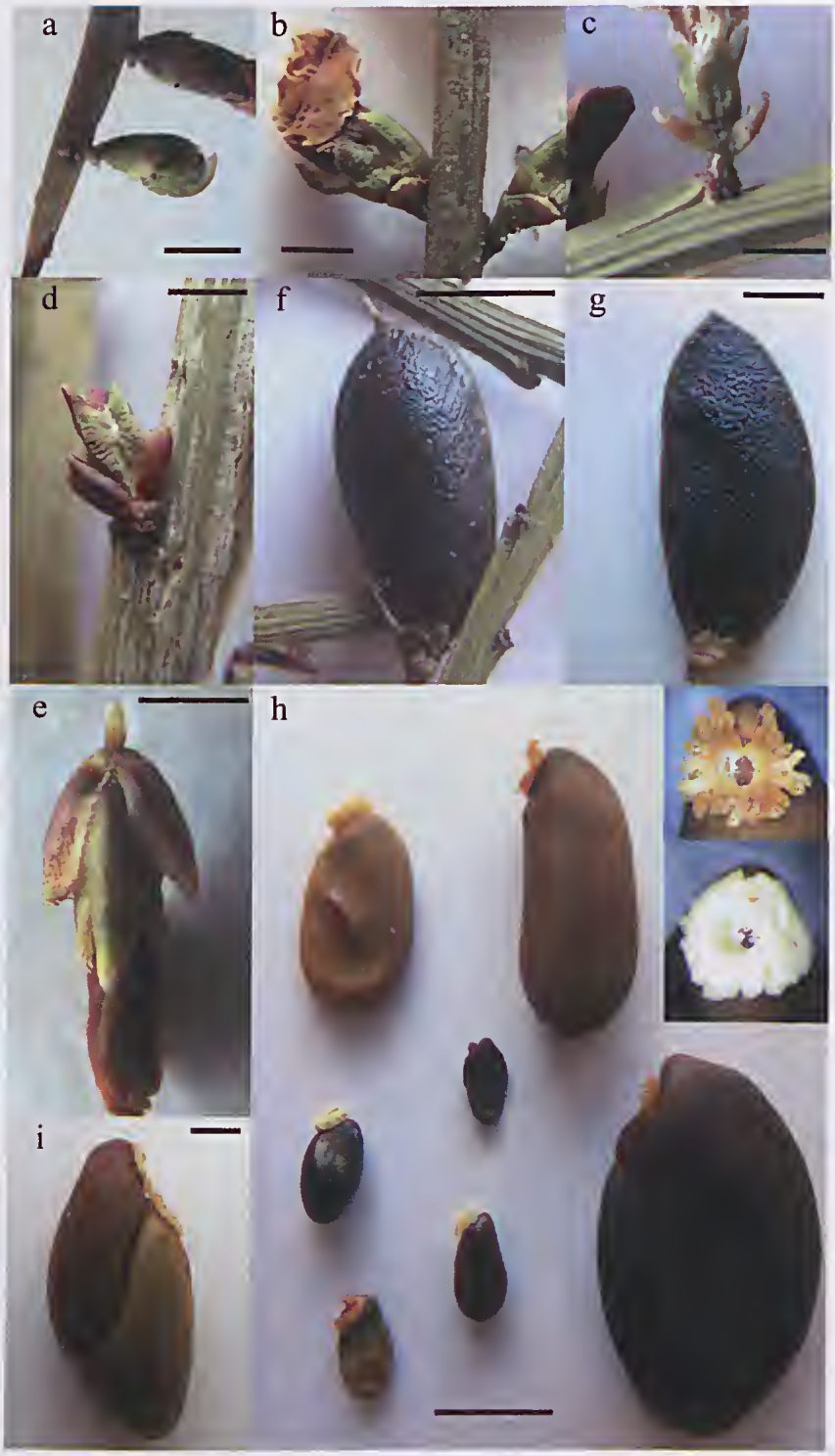

Figure 2. Flowers, fruit and seeds. a–e. Flowers. a. *Templetonia battii*, bud (*W.R. Archer 1009951* MEL); b. *T. battii* (*M. Hislop 2269* PERTH); c. *T. sulcata*, view from below (*H. Eichler 15913* AD); d. *T. ceracea*, bud, corolla just emerging (*T.R. Lally 1122* AD); e. *T. rossii*, view from above (*M.D. Crisp 986* PERTH). f–g. Pods. f. *T. sulcata* (*M.G. Corrick 11466* CANB); g. *T. incrassata* (*P.S. Short 2308 & L. Haegi* AD). h–i. Seeds (all more or less full size but immature seeds partly collapsed). h. Comparison of species, from l to r: top row: *T. egena* (*Browning* AD), *T. incrassata* (*D.E. Symon 1115* AD; upper inset showing aril); middle row: *T. sulcata* (*B. Smith s.n.* PERTH; lower inset showing aril), *T. ceracea* (*Koch* MEL); bottom row: *T. battii* (*Ashby 39* AD), *T. rossii* (*B. Archer 485* PERTH), *T. smithiana* (*C. Chapman*, 25.xi.1972 PERTH); i. *T. egena*, seeds from one pod (*K.D. Rohrlach 697* AD). Scale bars: a–e, i = 2 mm; f–h = 5 mm.

compressed, not partitioned, 1- or 2(or 3)-seeded; valves sometimes dotted with glands. *Seeds* ellipsoid to oblong-ellipsoid, plump to somewhat compressed, 4–16 mm long, brown; hilum subapical; aril annular, *c.* circular or elliptic, wall variously thick, often with frilly lateral outgrowths, mostly cleft at summit; vertical lobe mostly present, arising apico-laterally; orifice 0.2–0.5 mm wide.

***Notes on morphology*:** BRANCHES (Fig. 1): Branches of all species have conspicuous prominences at nodes which are made more conspicuous by the presence of dark glandular material. The compressed branches seen in some species are reminiscent of those of the leafless *Bossiaea* species such as *B. walkeri*, but the *Templetonia* species are more prominently longitudinally ridged and they are more uniformly compressed. The leafless *Bossiaea* species also do not have glandular material in axils.

LEAVES AND STIPULES (Fig. 1): In most species linear leaf rudiments c. 0.5 mm wide are present on new growth, and these sometimes persist beyond the initial growth phase. Often the rudiments are only 1–2 mm long, but may be as long as 4 mm. Leaves do not have a discernible petiole but on close inspection the blade is seen to be strongly concave. Associated with each leaf is a pair of small, erect, triangular stipules. Best development of leaves occurs beyond the first four or five nodes and examination of fully grown branches for persistent rudimentary leaves should be directed at these nodes. Occasionally the lowermost node or two has a scale only and this is equivalent to the normal situation in *T. egena* and *T. incrassata* (described below). Figure 1b shows the progression of development of leaves and stipules along a branch. More basal stipules are often brown and chartaceous distally but further along a branch are entirely pale green. Over time leaves and stipules wither and become eroded so that often only the base of the structure remains as a ridge (coloured brown in Fig. 2c). The pale branch-margins in species with flattened branches are continuous with leaf rudiments, whereas the ridges on the faces trace to stipule bases and become more prominent nearer this termination (Fig. 2c).

In *T. egena* and *T. incrassata*, two of the three species with terete branches, a single scale is developed instead of a rudimentary leaf and paired stipules (Fig. 1a). The shape of these scales is more or less constant along a branch. Scales also gradually become eroded with age.

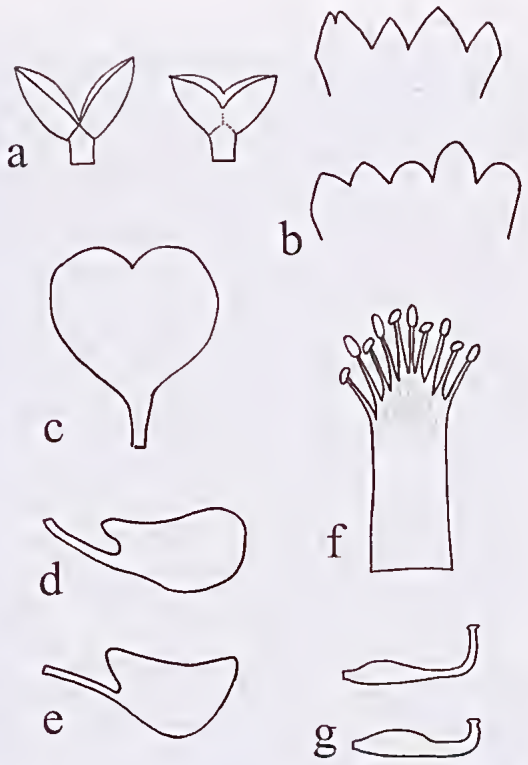

Figure 3. Flower parts (semi-diagrammatic, generalised). a. bracteoles, free and connate; b. calyx lobes (*Templetonia rossii* & *T. ceracea* type at top); c. standard; d. wing; e. keel; f. androecium, opened out; g. pistil (*T. battii* bottom). Scale (approximate) a–e. ×5; f. ×6; g. ×4.

BRACT AND BRACTEOLES (Figs 2 & 3): Bracts occupy a similar position to stipules and when two flowers arise from a node the two bracts can resemble a pair of stipules. They can be distinguished on close inspection as they will be inserted inner to a ridge which is the basal remnant of a stipule. Bracteoles are important in discriminating species. All species have bracteoles inserted more or less immediately below the receptacle and they extend over the calyx tube at anthesis. In some species they are connate while in others they are more or less free (Fig. 2a–d, 3a). They are green and often somewhat fleshy proximally, then abruptly change to chartaceous and brown. This brown zone less abruptly changes to a more or less clear zone distally and sometimes laterally. The apex and margins are generally ciliolate, and they develop splits to different extents depending on the species. The relative proportions of the green, brown and clear zones vary between species but are fairly constant

Key to species of *Templetonia*

Note: Branch widths or diameters are measured mid-internode. All measurements given in the key and descriptions are based on dried material.

1 Branches erect to suberect, terete, blunt at terminus; a triangular scale developed at nodes.....**2**

1: Branches moderately divergent, flattened, or if ever terete then also tapering into a spine-like terminus; a pair of triangular stipules and a leaf rudiment developed at nodes (often only obvious on new growth).....**3**

2 Flowering-branch diameter mostly < 1.5 mm, with ridges well-defined; pedicels > 1 mm long at flowering; standard-limb 3–4 times length of claw; pods commonly < 18 mm long.....**1. *T. egena***

2: Flowering-branch diameter mostly > 1.5 mm, with ridges generally poorly defined; pedicels < 1 mm long at flowering; standard-limb c. 2 times length of claw; pods mostly > 18 mm long.....**2. *T. incrassata***

3 Branches terete; bracteole usually with a tuft of glandular material at apex; style c. 2 mm long.....**3. *T. battii***

3: Branches flattened; bracteoles with glandular material absent or in minute amounts; style c. 3 mm long.....**4**

4 Branches spine-like (tapering and becoming terete, c. 0.1–0.2 mm wide at tip); bracteoles brown and chartaceous in distal 2/3 only; lower medial calyx lobe incurved not brown-chartaceous; flower buds rounded at apex.....**5**

4: Branches not spine-like (tapering but flattened and at least 0.5 mm wide at tip); bracteoles almost entirely brown and chartaceous; lower medial calyx lobe straight, brown-chartaceous distally, flower buds acute at apex.....**6**

5 Pods 5–6 mm wide, 10–13 mm long; seeds 3.5–4.5 mm long; flowering branches 1.5–3.5(–4.5) mm wide, sometimes minutely papillose.....**4. *T. sulcata***

5: Pods 9–12 mm wide, 15–28 mm long; seeds 9–16 mm long; flowering branches 3–8 mm wide, smooth.....**5. *T. smithiana***

6 Branches not encrusted with epicuticular wax; flowering branches 2–7 mm wide; ovaries 2- or 3-ovulate; aril > 1 mm wide, frilly.....**6. *T. rossii***

6: Branches encrusted with epicuticular wax that lifts in sheets; flowering branches 1–3(–4) mm wide; ovaries 4-ovulate; aril < 1 mm wide, entire.....**7. *T. ceracea***

within a species. Minute amounts of reddish or dark glandular material may be detectable amongst the ciliolate apex in most species; however, in *T. battii* there is substantially more and it commonly forms a distinct tuft at the apex (Figs 2a–d).

FLOWERS (Fig. 2a–e & Fig. 3): The calyx is entirely or mostly green. It is sometimes somewhat fleshy and then tends to dry dark. The lower medial lobe of the calyx is brown and chartaceous apically and straight in *T. rossii* and *T. ceracea* at and before anthesis, but in other species it is green except for the clear margin and is distinctly incurved. This is particularly obvious in the flower bud where it covers other lobes of the calyx (Fig. 2a). The calyces of *T. rossii* and *T. ceracea* are also different in the structure of the upper lip. The two lobes are either completely fused or the apices of the two lobes are only slightly divergent and because of obscuring hairs, appear to be completely fused (Fig. 2e). Figure 3b shows the two fundamental types of calyx lobe morphology.

The standard in all species is arched upwards when viewed from the side prior to anthesis, and this is similar to the upwards curvature of both wings and keel. Anther dimorphism is conspicuous, with basifixed anthers approximately twice the length of the basifixed anthers (Fig. 3f). In *T. incrassata* the ratio is slightly greater than 2. As appears to be typical of the Brongniartieae, one stamen tends to become free from the sheath markedly more proximally than the other stamens; however, no free vexillary stamen has been recorded in this group. The sheath apex (with sheath opened out and flattened) is gently rounded except in *T. egena* in which it is commonly nearly truncate or even slightly emarginate.

PODS AND SEEDS: A feature of this group is the relatively high ratio of ovules to seeds. In many instances, less than half the ovules of an ovary are fertilised. Careful opening of semi-mature pods reveals the remnant ovules.

There is considerable variation in seed size in this

group. The outgrowths from the aril margin that give it a frilly appearance is seen in four of the species and is unique within the Brongniartieae. In two species the margin is crenate, while in *T. ceracea* the aril wall is entire. There appears to be some variability in extent of frilliness within species. The aril's vertical lobe is conspicuous in most species, but is indistinct in *T. egena* and apparently absent in *T. incrassata*.

Several of the species are illustrated in Ross (1982). For *T. sulcata* (Ross 1982, figure 13), illustrations a–i are drawn from *T. rossii*, and the presentation of anther size is inaccurate. The seed of *T. smithiana* is illustrated in Ross 1982, figure 15a–d as *T. sulcata*.

1. *Templetonia egena* (F.Muell.) Benth., *Fl. Austral.* 2: 170 (1864)

Daviesia egena F.Muell., *Trans. & Proc. Victorian Inst. Advancem. Sci.* 1854–55: 118 (1855); *Bossiaea egena* (F.Muell.) F.Muell., *in* W.J.Hooker, *Hooker's J. Bot. Kew Gard. Misc.* 8: 43 (1856).

***Type*:** South Australia. Murray scrub towards Morundam, *F. Mueller*, ii.1851, lecto: MEL20345, *fide* J.H. Ross, *Muelleria* 5: 18 (1982).

Shrubs to c. 3 m high, sometimes with branches weeping; flowering branches ±erect, straight, 0.8–1.5 mm in diameter, terete, mostly with well-defined ridges, not glaucous, not tapering terminally; new growth 0.5–0.8 mm in diameter. *Scale* present at nodes instead of leaf rudiments and stipules, triangular-ovate, 1–1.5 mm long. *Pedicels* 1–3 mm long; bract c. 1 mm long; bracteoles 1–1.5 mm long, shortly connate, chartaceous in distal half to third. *Flower buds* with apex rounded; calyx 2.5–4 mm long, tube 2–2.5 mm long, sinus of upper lip 0.5–1 mm deep with apices separated; median lower lobe moderately to much longer than other lobes, not chartaceous or brown; standard 5.5–9 mm long, limb c. as wide as long, claw 1–1.8 mm long; wings 5–8 mm long, 1.5 mm wide, claw c. 1.8 mm long; keel 5–7 mm long, 2 mm wide, pale greenish or tinged purple distally, claw c. 1.5 mm long; stamen-sheath c. 1.5 mm wide flattened-out; ovary 5- to 8-ovulate; style 2.5–4 mm long. *Pods* c. elliptic in profile, (11–)13–18(–22) mm long, 5–11 mm wide, 1- or occasionally 2-seeded; valves dotted with minute glands. *Seeds* compressed-ellipsoid, 7–9(–11) mm long, 3.5–5 mm wide, brown; aril 1.5–3.5 mm in diameter, with fine lateral outgrowths, cleft at summit distinct, vertical lobe not or only obscurely evident.

***Selected specimens of c. 300 examined*: WESTERN AUSTRALIA.** 1 km SE of Mindi Springs, Hamersley Range National Park, *M.E. Trudgen 7241*, 15.x.1990 (PERTH); 14.9 km NNE of Bullen Hill, Little Sandy Desert, *S. van Leeuwen 5124*, 5.ix.2002 (CANB, PERTH); c. 101 km S of Munjina Roadhouse on Northern Hwy, *A.A. Mitchell PRP1004*, 3.xi.1995 (PERTH); Tom Price mine site, *K. Atkins*, 10.ix.1980 (PERTH). **NORTHERN TERRITORY.** 9 km W of Idracowra – Palmer Valley boundary, *J.R. Maconochie 2432* , 14.ix.1978 (AD, BRI, CANB, DNA, MEL 2000125); 2 km SE of Princes Bore, Alcoota Station, *B. Strong*, 20.xi.1979 (DNA); 8 km S of Yuendumu, *T.S. Henshall 2822*, 5.xii.1979 (CANB, DNA, MEL 567854). **SOUTH AUSTRALIA.** 32 km S of Yunta, *N.N. Donner 3715*, 2.x.1971 (AD, BRI); Willochra, c. 20 km NE of Quorn, *R. Hill 1401* (AD, CANB); 'Gluepot' station, c. 12 km NE of homestead, c. 103 km NW of Renmark, *I. Crawford 4439* (AD, CANB, MEL 2270988, NSW); Kunatjara, Tomkinson Ranges, *A. Kalotas 1433*, 15.xi.1982 (AD, DNA). **QUEENSLAND.** c. 24 km 55E of Blackwater township, *M. Lazarides & R. Story 56*, 6.ix.1961 (BRI, CANB, MEL 1507638). **NEW SOUTH WALES.** Broken Hill, *A. Morris 62*, 28.xi.1919 (MEL 564728); Boppy Mount area, Cobar, *J.B. Cleland*, 14.ix.1911 (AD, MEL 564727); c. 12 km E of Balranald on road to Hay, *M.E. Phillips*, 31.viii.1962 (CANB, DNA); Kimberley Station, c. 80 km SE of Cockburn, *E.F. Constable*, 25.vii.1955 (DNA, NSW); Harvey Ranges, *J.L. Boorman*, xi.1905 (BRI, NSW). **VICTORIA.** Redcliffs, N of town between railway line and road, *M.G. Corrick 7463* (AD, MEL 592031); Meringur Bushland Reserve, 15 km E of Mortlake, *A.C. Beauglehole 57011*, 31.x.1977 (MEL); Swan Hill, *J.G. Luehmann*, 1890 (MEL); Mildura, *H.B. Williamson*, 9.xii year unknown (MEL); Wemen, Robinvale District, *A.R. Begg*, viii.1960 (MEL).

***Distribution and habitat*:** Occurs in southern, central and north-eastern Western Australia, southern Northern Territory, South Australia, central-eastern Queensland, western and central New South Wales, and north-western Victoria (Fig. 4). Grows in sandy soils in woodland, grassland and shrubland.

***Flowering period*:** Flowers late winter to summer.

***Notes*:** The upper calyx lobes of *T. egena* are similar to the lateral lobes but slightly more triangular and are fused in the proximal third to half. Occasional 2-seeded pods have been seen in which the seeds are abnormally shaped due to a lack of room for normal expansion (Fig. 2i). The aril in *T. egena* is highly variable in diameter and the degree of dissection of the margin. Based on a

small survey of flowers, the stamen sheath of *T. egena* differs slightly from the other leafless species in the shape of the apex of the stamen sheath and the free filament portion is relatively long. In other species of Templetonia the sheath apex is rounded (Fig. 3f). *Templetonia egena* is one of two species to have a scale at nodes, *T. incrassata* being the other. These two species are further distinguished from other leafless species of *Templetonia* by the bead-like appearance of the epidermis (seen under magnification), their relatively erect branches, their pod valves with glands more conspicuous at maturity, and the relatively small or absent aril lobe.

2. *Templetonia incrassata* I.Thomps., *sp. nov.*

A T. egena *(F.Muell.) Benth. ramis crassioribus sulcis non profundis plerumque glaucis, pedicellis brevioribus, leguminibus longioribus, seminibus longioribus differt.*

***Type*: SOUTH AUSTRALIA.** 22 km south of Mount Christie Corner, Mobella Station, 30°31'11"S, 133°30'03" E, *F.J. Badman 8257*, 3.ix.1995; holo: AD 99647245; iso: AD 99644643.

Erect shrubs to c. 2.5 m high; flowering branches suberect, straight, 1.5–2.5 mm in diameter, terete, with generally poorly defined ridges, often glaucous, not tapering terminally; new growth c. 1 mm in diameter. *Scale* present at nodes instead of leaf rudiments and stipules, triangular-ovate, 0.6–1.2 mm long. *Pedicels* 0.3–1 mm long; bract c. 1 mm long; bracteoles 1.5–2.2 mm long, shortly connate, chartaceous in distal third. *Flower buds* with apex rounded; calyx 3–4.5 mm long, tube 2–3.2 mm long, sinus of upper lip c. 0.5 mm deep with apices separated; median lower lobe slightly to much longer than other lobes, not chartaceous or brown; standard 5.5–8 mm long, limb slightly wider than long, claw 2–2.5 mm long; wings 5–7 mm long, 2 mm wide, claw 2.5 mm long; keel 5–6.5 mm long, 2.2 mm wide, generally dark purple distally, claw 2 mm long; stamen sheath c. 1.8 mm wide flattened-out; ovary 6-ovulate; style 2.5–3.5 mm long, slender distally. *Pods* obliquely oblong-elliptic in profile, mostly 16–25 mm long, 7–10 mm wide, 1(or 2)-seeded; valves dotted with minute glands. *Seeds* oblong-ellipsoid, 9–14 mm long, 4–5 mm wide, brown; aril 1.5–3 mm in diameter, with wall crenate to deeply lobate, vertical lobe not evident.

***Selected specimens of c. 40 examined*: WESTERN AUSTRALIA.** c. 12 km S of Menzies, *A.S. George 2718*, 21.viii.1961 (PERTH); c. 38 km E of the intersection of the Mt Jackson–Diemals road and the Diemals–Menzies Rd, *P.S. Short 2308 & L. Haegi*, 5.xi.1983 (AD, MEL 1524851, PERTH); Goddard Creek, along Transcontinental Rly, *R.D. Royce 5567*, 3.x.1956 (CANB); 32 km from Coolgardie towards Kalgoorlie, *E.M. Conning*, 7.ix.1968 (CANB); 26 km ENE of Cosmo Newbury Mission, *N. Forde 1385*, 14.x.1960 (CANB); 500 m E of Lake Raeside, Kirgella Rocks Station, *H. Pringle 2402*, 13.vii.1989 (CANB, PERTH); Victoria Desert, Camp 54, *R. Helms*, 11.ix.1891 (MEL 564626); Mt Elvire Station, *B.H. Smith s.n.*, 23.viii.1981 (MEL 590013). **SOUTH AUSTRALIA.** Yellabinna Regional Reserve, *F.J. Bodmon 11575*, 18.viii.2005 (AD); SW corner of Commonwealth Hill Station, c. 40 km NW of Wynbring railway station, *D.E. Symon 1115*, 2.xii.1960 (AD, DNA); c. 6 km N of Red Lake along roadside, *J.Z. Weber 8218*, 22.x.1983 (AD); Nundroo Well, *R.H. Ashby*, 15.xi.1975 (AD); c. 46 km S of Ooldea, *P. Wilson 1830*, 23.ix.1960 (AD); SW of Anthony Lake, Commonwealth Hill Station, c. 90 km NNW of Tarcoola, *B. Loy 64*, 3.ix.1970 (AD); c. 6 km N of Red Lake along roadside, *J.Z. Weber 8218*, 22.x.1983 (AD).

***Distribution and habitat*:** Occurs in central-western Western Australia and central-western South Australia (Fig. 4). Grows in various soils including sands and calcareous sands, often near lake margins, in woodland, shrubland and grassland.

***Flowering period*:** Flowers winter to early spring.

***Etymology*:** The epithet refers to the relatively thick branches when compared to *T. egena* (L: *incrassatus*, thickened).

***Notes*:** Apart from the distinctions given in the key, *T. incrassata* is more often glaucous than *T. egena*, has a plumper calyx, a standard petal with a longer claw, broader wings and a keel that is usually more purple. Further floral distinctions based on a limited survey of specimens include greater anther dimorphism, a stamen sheath that is more prolonged centrally, and filaments shorter beyond the sheath.

3. *Templetonia battii* F.Muell., *Australas. Chem. Druggist* 2(2): 31 (1887)

Bossiaea battii (F.Muell.) Tate, *Handb. Fl. Extratrop. S. Australia* 65 (1890).

***Type*:** Western Australia. Eucla, *J.D.Batt*; syn: MEL 564735; Western Australia. Eucla, *J.D.Batt*; syn: MEL 564736.

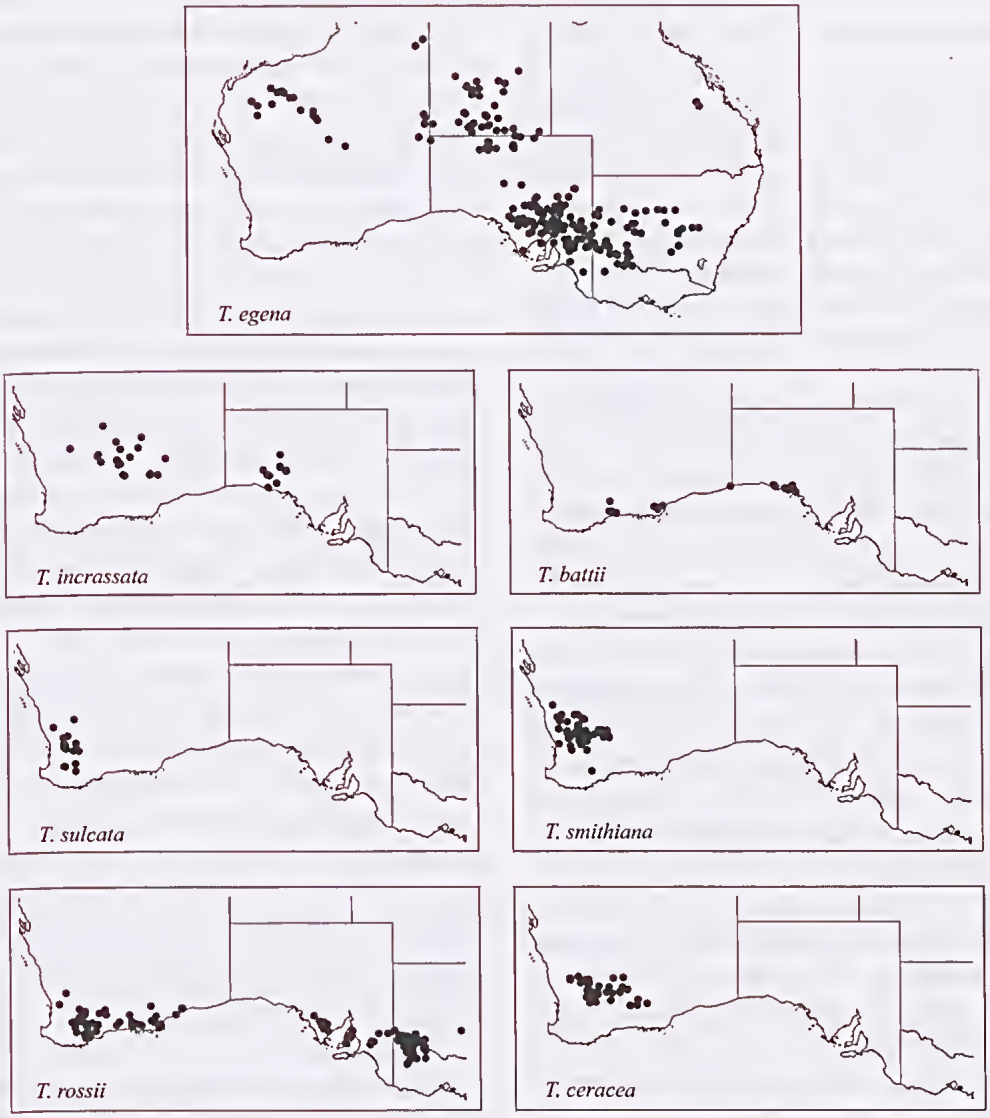

Figure 4. Distributions of *Templetonia egena*, *T. incrassata*, *T. battii*, *T. sulcata*, *T. smithiana*, *T. rossii* and *T. ceracea*.

Erect shrubs to c. 1.5 m high; flowering branches divergent, often slightly flexuose, 1–2 mm in diameter mid-internode, terete, mildly ridged, sometimes minutely and finely papillose, tapering terminally to form a dark, spine-like apex 0.1–0.2 mm wide at tip; new growth c. 0.5 mm wide. *Leaf rudiments and stipules* developed at nodes; leaf rudiments to c. 1 mm long, sometimes scale-like basally. *Pedicels* 0.5–1.5 mm long; bract c. 0.5 mm long; bracteoles 1.5–2 mm long, connate for up to half of length, chartaceous in distal third to quarter, apex generally remaining intact, usually with a tuft of red glandular material. *Flower buds* with apex rounded; calyx 2–3.5 mm long, tube 1.5–2 mm long, sinus of upper lip 0.5–1 mm deep with apices separated, lower median lobe much longer than other lobes, not chartaceous or brown, arching strongly inwards; standard 5.5–6 mm long, limb wider than long, 6–7 mm wide, claw 0.5–1.5 mm long; wings 4–5 mm long, 2 mm wide, claw c. 1.5 mm long; keel 3.5–4.5 mm long, 1.5 mm wide, dark purple distally, claw c. 1.5 mm long; stamen sheath 1.5 mm wide flattened out; ovary 6-ovulate, style c. 2 mm long, rather stout. *Pods* elliptic in profile, 8–15 mm long, 4–7 mm wide, 1- or 2-seeded; valves not gland-dotted. *Seeds* ellipsoid,

4.5–5 mm long; aril 1.5–2 mm in diameter, wall frilly, with long outgrowths, vertical lobe c. 0.5 mm high.

***Selected specimens of c. 30 examined*: WESTERN AUSTRALIA.** 1 Martin St., Ravensthorpe, *M. Hislop 2269*, 12.viii.2001 (PERTH); c. 20 km WSW of Ponier Rock, c. 78 km S of Balladonia Motel, Eyre Hwy, *K. Newbey 7360*, 14.ix.1980 (PERTH); 10 km E of Buraminya, 143 km NE of Esperance, *W.R. Archer 1009951* (MEL 2035026, PERTH). **SOUTH AUSTRALIA.** 14 km NW of Penong towards Bookabie, *J. Taylor 1510 & P. Ollerenshaw* (AD, CANB, MEL 653023); 16 km from Penong to Ceduna, c. 1 km along small side road, *H.R. Toelken 7750*, 25.x.1983 (AD); Yumburra Conservation Park, S side of plain near Maningilla rock holes, *R.H. Ashby 39*, xii.1985 (AD).

***Distribution and habitat*:** Occurs in far south-central Western Australia, east of Lake King, and south-western South Australia as far east as Denial Bay (Fig. 4). Grows in sandy and loamy soils, usually on limestone in shrubland and woodland.

***Flowering period*:** Flowers winter to spring.

***Notes*:** The large convex and curved medial lower lobe of the calyx is responsible for the rounded apex of the bud. Although this feature is also seen in four other species in the leafless group, it is particularly apparent in *T. battii*. Of all the leafless species, *T. battii* is the only one with conspicuous development of glandular material at the apex of the bracteoles. In other species minute amounts of glandular material are sometimes evident. *Templetonia battii* also has the shortest, stoutest style in the group and the keel and wing auricles are relatively weakly developed. Microscopically the surface of branches is often minutely and finely papillose; *T. sulcata* is similar in this respect. The leaf and stipule development in *T. battii* occasionally shows some intermediacy between the scale formation of *T. egena* and *T. incrassata* and the linear leaf rudiments developed in *T. sulcata*, *T. smithiana*, *T. rossii* and *T. ceracea* as leaf rudiments are sometimes relatively broad.

4. *Templetonia sulcata* (Meisn.) Benth., *Fl. Austral.* 2: 171 (1864)

Bossiaea sulcata Meisn., *in* J.G.C.Lehmann, *Pl. Preiss.* 1: 81 (1844).

***Type*:** Western Australia. Avon River, York, *J.A.L.Preiss* 1028; holo: K *n.v.*, photo MEL 584229.

Erect shrubs to c. 1.5 m high; flowering branches moderately to strongly divergent, straight, 2–3 mm wide, moderately compressed, sharply ridged, smooth or minutely and finely papillose, tapering terminally to form a dark spine-like apex, with tip 0.1–0.2 mm wide; new growth 1–1.4 mm wide. *Leaf rudiments and stipules* developed at nodes; leaf rudiments to c. 4 mm long, tending to persist on longer branches. *Pedicels* 0.5–1 mm long; bract c. 0.5 mm long; bracteoles 0.8–1.5 mm long, free or nearly so, chartaceous in distal half to two-thirds, apex often splitting and/or becoming ragged. *Flower buds* with apex rounded; calyx 2.5–3.5 mm long, sinus of upper lip c. 0.5 mm deep with apices separated, lower medial lobe slightly longer than other lobes, not chartaceous or brown; standard 5–6 mm long, limb c. as wide as long, 4–5 mm wide, claw 1–1.5 mm long; wings 5 mm long, 1.5 mm wide, claw c. 2 mm long; keel 5 mm long, 2 mm wide, dark purple distally, claw 1.5–2 mm long; stamen sheath 1.2–1.5 mm wide flattened out; ovary 5- or 6-ovulate, style 2.5–3 mm long. *Pods* narrow-elliptic in profile, 9–14 mm long, 5–6 mm wide, 1–4-seeded; valves not gland-dotted. *Seeds* ellipsoid, 4–4.5 mm long; aril 1.5–1.8 mm in diameter, wall crenate, vertical lobe c. 0.3 mm high.

***Selected specimens of c. 80 examined*: WESTERN AUSTRALIA.** Near Mortlock River, 9 km SW of Goomalling, *A.S. George 15740*, 1.ix.1979 (PERTH); Avon region, c. 1.5 km SW of Manmanning, *B.H. Smith 1604*, 3.viii.1992 (CANB, PERTH); c. 40 km E of Wongan Hills on Avon 24861 on Phillip's farm, Landeny, *L.A. Phillips 29*, 27.viii.2006 (PERTH); Beverley Airfield reserve, c. 1 km S of Beverley, *M. Ochtman & D. Lynch 22*, 18.ix.2000 (PERTH); Gwambygine, near York, *J. Seabrook s.n.*, 7.ix.1980 (PERTH); c. 6 km W of Dumbleyung to Wagin, *B.R. Maslin 652*, 2.viii.1970 (PERTH); Mt Hardy, c. 10 km E of York, *B. Smith 206*, 18.xii.1982 (CANB, MEL 626709, PERTH); c. 19 km from Broomehill towards Growanjerup, *J.W. Wrigley*, 21.x.1968 (CANB); Along road and railway line between Katanning and Tambellup, c. 7 km S of Broomehill, *H. Eichler 15913*, 31.viii.1959 (AD).

***Distribution and habitat*:** Occurs in south-western Western Australia between 30° and 34°S and between 116° and 117°40'E (Fig. 4), largely overlapping the distribution of *T. smithiana*. Grows in sands and loams in shrubland and woodland.

***Flowering period*:** Flowers winter to spring.

***Notes*:** Similar to *T. smithiana* in bracteole, calyx and branch-tip morphology, but with very different pod and seed morphology. Also, *T. sulcata* does not

grow as large as *T. smithiana*, its branches are generally narrower, and the rudimentary leaves are often better developed and more persistent. The branch surface is sometimes minutely papillose unlike the consistently smooth surface in *T. smithiana*. Bracteoles of *T. sulcata* and *T. smithiana* have a distinctive tricolour appearance, with bands green proximally, light brown centrally, and whitish-translucent distally. The distal portion tends to become quite ragged through splitting.

Templetonia sulcata can be distinguished from *T. rossii* by branch-tip and bracteole features, as given in the key, and by its plumper seeds with an aril crenate rather than frilly and with a lower, broader lobe, and by the pods which are narrower but deeper and have a longer beak.

Chromosome numbers given in Sands (1975) under *T. sulcata* are all referrable to other species (see *T. ceracea*, *T. smithiana* and *T. rossii*).

5. *Templetonia smithiana* J.H.Ross, *Muelleria* 5: 278 (1984)

***Type*:** Western Australia. Doodarding, No. 2 Rabbit fence, 0.25 mile (c. 0.4 km) N of gate 44, 31°01'S, 117°12' E, *B.H. Smith 204*, 13.xii.1982; holo: MEL 626707; iso: K, PERTH, both *n.v.*

Erect shrubs to c. 1.5 m high; flowering branches moderately divergent to almost spreading, often flexuose, 3–6(–7) mm wide, strongly compressed, with ridges often sharply defined, smooth, tapering terminally to form a dark, spine-like apex, with tip 0.1–0.2 mm wide; new growth 2.5–3 mm wide. *Leaf rudiments and stipules* developed at nodes; leaf rudiments to 3 mm long. *Pedicels* 1–1.5 mm long; bract c. 0.5 mm long; bracteoles 1–1.5 mm long, free or nearly so, chartaceous in distal half to two-thirds, apex often splitting and or becoming ragged. *Flower buds* with apex rounded; calyx 3–4 mm long, tube 2–3 mm long, sinus of upper lip c. 0.5 mm deep, with apices separated; lower medial lobe moderately longer than other lobes, not chartaceous; standard 6–8 mm long, limb c. as wide as long, 5–7 mm wide, claw 1.5 mm long; wings 1.8 mm wide, claw 2.3 mm long; keel 1.5 mm wide, with claw c. 2 mm long, dark purple distally; stamen sheath 1.8 mm wide flattened out; ovary 5-ovulate, style 3–4 mm long. *Pods* elliptic in profile, 15–28 mm long, 9–12 mm wide, 1-seeded; valves with glands sometimes faintly detectable. *Seeds* compressed ellipsoid, 9–16 mm long; aril 1 mm in diameter, wall entire or slightly crenate, vertical lobe c. 0.4 mm high.

***Selected specimens of c. 60 examined*: WESTERN AUSTRALIA.** Mt Hardy, 11 km from York on road to Quairading, *J.H. Ross 2773* (CANB, MEL 626714); Doodarding, c. 0.4 km N of 44 gate, no. 2 rabbit fence, *B.H. Smith 1346* (BRI, MEL 1587441, PERTH); 28 km N of Bullfinch on Bullfinch–Evanston Rd, *L.A. Craven 4555 & B.J. Lepschi*, 6.xi.2000 (CANB, PERTH); c. 11 km E of Winchester, *C. Chapman*, 25.xi.1972 (PERTH); Mt Gibson Station, *S. van Vreeswyk 3858*, 27.viii.1993 (PERTH).

***Distribution and habitat*:** Occurs in far south-western Western Australia mostly north of 32°15'S (Fig. 4). Grows on sandy-loam rises, often near salt lakes.

***Chromosome number*:** 2n = 16 (Sands 1975; collection no. 637.4.1 PERTH 02900556, as *T. sulcata*).

***Flowering period*:** Flowers August to October.

***Notes*:** Closely related to *T. sulcata*, with which it is partly sympatric, having more or less identical floral and bracteole morphology and in having similarly spinescent branches, but markedly different in branch width and in dimensions of fruits and seeds. Branches are similar to those of *T. rossii* in terms of width and colour (at least when dry). However, branches of *T. rossii* are not spiny and the surface of branches are generally minutely granular (most easily detected along the hyaline edge of the branch at ×10–×20). In *T. smithiana* more so than other species, there is a tendency for the funicle and placenta to detach with the seed.

A collection from Koorda NW of Merredin (*Blackall* PERTH 02900610) has relatively short internodes and shows evidence of being atypically succulent.

6. *Templetonia rossii* (F.Muell.) I.Thomps., *comb. nov.*

Bossiaea rossii F.Muell., *Fragm.* 3: 94 (1862).

***Type*:** Victoria. Avoca River, *?F. Mueller*; lecto: MEL 20342, *fide* J.H. Ross, *Muelleria* 5: 27 (1982).

Erect shrubs to c. 1.5 m high; flowering branches moderately divergent, ±straight, 2–7 mm wide, moderately compressed, mildly ridged, smooth or more often minutely granular, sometimes glaucous, tapering terminally but not spine-like and not becoming terete (apex c. 0.5 mm wide); new growth 2–3 mm wide. *Leaf rudiments and stipules* developed

at nodes; leaf rudiments to c. 2 mm long. *Pedicels* 0.5–1.5 mm long; bract c. 1 mm long; bracteoles 1–3 mm long, almost entirely chartaceous, apex tending to remain intact. *Flower buds* with apex acute; calyx 2.5–3.5 mm long, sinus of upper lip hardly developed or to c. 0.5 mm deep, with apices hardly separated, lower medial lobe moderately longer than other lobes, chartaceous distally; standard c. 6 mm long, limb 5.5. mm wide, claw 1–1.5 mm long; wings 5 mm long, 2 mm wide, claw c. 1.5 mm long; keel c. 4.5 mm long, c. 2 mm wide, pale or purple distally, claws 1.5 mm long; stamen sheath 1.2–1.4 mm wide flattened out; ovary 2- or 3-ovulate, style c. 3 mm long. *Pods* elliptic or oblong-elliptic in profile, 8–12(–16) mm long, 6–7 mm wide, without basal projection, 1 or 2 (or 3)-seeded; valves not gland-dotted. *Seeds* 3.5–5 mm long; aril 1.5–2 mm in diameter, wall frilly, with numerous short lateral outgrowths, vertical lobe c. 0.5 mm high.

***Selected specimens of c. 200 examined*: WESTERN AUSTRALIA.** 14.9 km E of Wagin on road to Dumbleyung, *T.R. Lally 1253 & B.J. Lepschi*, 22.ix.1996 (CANB, MEL 2095147, PERTH); 37 km N of Katanning on road to Dumbleyung, 15 km S of Dumbleyung, *G.J. Keighery 6340*, 26.viii.1983 (PERTH); 26 km S of Deralinya Ruins on Parmango Rd, 89 km NE of Condingup, *B. Archer 485*, 12.xii.1986 (CANB, MEL 2036768, PERTH). **SOUTH AUSTRALIA.** 5.5. km S of Wharminda on road to Tumby, *D.J. Duval 553* (AD); Blue Range, Hincks National Park, c. 1 km S of Oak Amphitheatre, *C.R. Alcock 2273*, 8.x.1968 (AD); hundred of Wiltunga, Yorke Peninsula, c. 140 km NNW of Adelaide, *B. Copley 621*, 16.ix.1966 (AD); c. 5 km S of Bute, *B. Copley 874*, 8.xi.1966 (AD). **NEW SOUTH WALES.** Sturt Hwy, c. 29 km from Euston towards Buronga, *R.G. Coveny 18762* (AD, BRI, CANB, MEL 2105426); 20 km W of Balranald, *W.E. Mulham 1222* (CANB). **VICTORIA.** c. 22 km N of Birthday Tank, Sunset Country, *R. Filson 7428*, 24.ix.1965 (AD, MEL 645657); 1 km E of Nyah West on Nyah West to Murray Valley Hwy Rd, *B. Hadlow 640*, 7.ix.1991 (CANB, MEL 290510); 54.3 km E of the North-South Settlement Rd and Pheeny's Track junction, on Pheeny's track, Murray Sunset National Park, *J. McAuliffe 562*, 2.ix.2003 (CANB).

***Distribution and habitat*:** Occurs in southern Western Australia, south-eastern South Australia, north-western Victoria and south-western New South Wales (Fig. 4). Grows in sands and loams in shrubland and woodland.

***Chromosome number*:** 2n = 16 (Sands 1975; collection no. 638.15.10, PERTH 02900432, as *T. sulcata*).

***Flowering period*:** Flowers September to October.

***Notes*:** Branches are mostly minutely roughened and apparently they exude a sticky substance as a smattering of fine debris is commonly seen in pressed specimens. The slight elevations of branch surfaces are less prominent than the papillae often seen in *T. sulcata* and *T. battii*. *Templetonia rossii* and *T. ceracea* are closely related based on bracteole and calyx morphology; however, aril morphology is quite different. The bracteoles of *T. rossii* and *T. ceracea*, as well as being more extensively chartaceous and brown than in other species, tend to be more convex abaxially and a groove is often present at the boundary of brown-chartaceous and herbaceous portions.

7. *Templetonia ceracea* I.Thomps., *sp. nov.*

A T. sulcata *(Meisn.) Benth. ramis ceraceis angustioribus minus compressis, bracteolis fere omnino chartaceis, margine arillorum integro differt; a* T. rossii *(F.Muell.) I.Thomps. ramis ceraceis angustioribus minus compressis, floribus magnioribus, margine arillorum integro differt.*

***Type*:** Western Australia. 87.7 km west of Coolgardie Post Office, *B. Archer 1152*, 6.x.1998; holo: MEL 2068186; iso: CANB, PERTH.

Erect shrubs to c. 1.5 m high; flowering branches moderately divergent, ±straight, 1.5–2 mm wide, slightly to moderately compressed, mildly ridged, smooth beneath sheets of epicuticular wax; tapering terminally but not spine-like and not becoming terete (apex c. 0.5 mm wide); new growth 1.5–2 mm wide. *Leaf rudiments and stipules* developed at nodes; leaf rudiments to c. 3 mm long. *Pedicels* 0.5–1.5 mm long; bract c. 1 mm long; bracteoles 1–2.5 mm long, almost entirely chartaceous, apex tending to remain intact. *Flower buds* with apex acute; calyx 3–4.5 mm long, tube 2–3.5 mm long, sinus of upper lip hardly developed or to 0.5 mm deep, with apices not or only slightly separated; lower medial lobe moderately longer than other lobes, chartaceous distally; lateral lobes sometimes chartaceous distally; standard c. 7 mm long, limb c. as wide as long, c. 6 mm wide, claw 1–1.5 mm long; wings c. 6 mm long, 2.5 mm wide, claw c. 2 mm long; keel c. 5 mm long, c. 2 mm wide, light purple distally, claws c. 2 mm long; stamen sheath c. 1.5 mm wide flattened out; ovary 4-ovulate, style c. 3 mm long. *Pods* elliptic or oblong-elliptic in profile,

7–10 mm long, 4–7 mm wide, 1- or 2-seeded; valve not gland-dotted. *Seeds* c. 4 mm long; aril 0.7 mm in diameter, wall entire, not cleft at summit, vertical lobe c. 0.5 mm high.

***Selected specimens of c. 60 examined*: WESTERN AUSTRALIA.** Nungarin, *C.A. Gardner*, 24.viii.1920 (PERTH); 57 km E of Norseman on Eyre Hwy, *R.J. Cronfield 10026*, 16.viii.1995 (PERTH); 87.7 km W of Coolgardie PO, 5.8 km E of Boorabbin Microwave Tower, *B. Archer 1152*, 6.x.1998 (CANB, MEL 2068186, PERTH); c. 32 km S of Coolgardie, *R.D. Royce 3463*, 8.viii.1951 (PERTH); 16 km SSE of Jaurdi Homestead, c. 63 km E of Koolyanobbing, *K. Newbey 8952*, 18.ix.1981 (PERTH); Southern Cross, *W. Middleton*, 1.xii.1962 (MEL 593423); 1.2 km NW of Bruce Rock South Rd turnoff on Bruce Rock–Narabeen Rd, 3 km SE of Bruce Rock, *T.R. Lolly 1122 & B.J. Lepschi*, 10.viii.1996 (AD, HO, CANB, MEL 271045, NSW); Merredin, *M. Koch*, 10.ix.1923 (MEL).

***Distribution and habitat*:** Occurs in south-western Western Australia (Fig. 4). Grows in red-brown clay loams, and sandy loams in low woodland.

***Chromosome number*:** 2n = 16 (Sands 1975; collection no. 637.3.2 PERTH 02899256, as *T. sulcata*; however, recorded as 2n = 14 on herbarium label and in Sands 1966).

***Flowering period*:** Flowers winter to spring.

***Etymology*:** The epithet refers to the epicuticular wax coating the surface of branches (L. *ceraceus*, waxy).

***Notes*:** A loose, crusty epicuticular wax lifting from the surface of branches of *T. ceracea* is unique in the genus. *Templetonia rossii* is likely to be its closest relative based on calyx lobe and bracteole morphology. In these characters they are virtually indistinguishable; however, the bracteoles of *T. ceracea* tend to have a broader clear zone, the lower medial lobe of the calyx generally often has a more sharply demarcated chartaceous apex and the lateral lobes are more often chartaceous at the tips. Small differences are evident in the the petals, and fertile parts; those of *T. ceracea* are on average c. 1 mm longer than in *T. rossii* and the stamen sheath is markedly broader. The aril of seeds of *T. ceracea*, based on very few seeds seen, are distinctive for their small size and entire margin. Pods are the smallest in the group but only slightly smaller than in *T. rossii* and *T. battii*, and based on a small sampling are always 4-ovulate with all ovules attach to the same valve. Pods of collections from Southern Cross (*W.Middleton* MEL) and Merredin (*M.Koch* MEL) have a slight protuberance of the suture adjacent to the stipe; this has not been seen in pods of other species.

One specimen from the Hunt Range on Jaurdi Station, (*L.W.Sage 1591* PERTH) entirely lacks encrustations but appears, based on branch width and degree of compression, to be *T. ceracea*. The branches of this specimen have an unusual varnished appearance which may represent aberrant development.

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References

Ross, J.H. (1982). A revision of the genus *Templetonia* R.Br. (Papilionaceae). *Muelleria* **5**, 1–29.

Ross, J.H. (1984). The application of the name *Templetonia sulcata* (Meisn.) Benth. and a new species of *Templetonia* R.Br. (Papilionaceae) from Western Australia. *Muelleria* **5**, 277–280.

Ross, J.H. (2001). Two new endemic Australian genera in the Tribe Brongniartieae (Fabaceae) to accommodate two species formerly included in *Templetonia* R.Br. *Muellerio* **15**, 7–14.

Sands, V.E. (1966). Cytogenetics of Australian Leguminosae. PhD thesis: University of Sydney.

Sands, V.E. (1975). The cytoevolution of the Australian Papilionaceae. *Proceedings of the Linneon Society of New South Wales* **100**, 118–155.

Thompson, I.R., Ladiges, P.Y. and Ross, J.H. (2001). Phylogenetic Studies of the Tribe Brongniartieae (Fabaceae) using nuclear DNA (ITS-1) and Morphological Data. *Systematic Botany* **26**, 557–570.

A Revision of *Cristonia* (Fabaceae: Brongniartieae)

a259433

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Abstract

A revision of the Western Australian genus *Cristonia* J.H.Ross (Fabaceae: Brongniartieae) is presented. The number of taxa is increased from one to three. *Bossioea biloba* var. *stenophylla* Meisn. is resurrected and recombined at species rank to become *Cristonia stenophylla* (Meisn.) I.Thomps. and *Cristonia biloba* subsp. *pubescens* I.Thomps. is described as new. Distribution maps and identification keys are presented.

Keywords: taxonomy, *Templetonia*, legume, Western Australia.

Muelleria 28(1): 66-73 (2010)

Introduction

Cristonia J.H.Ross. is one of six Australian genera in tribe Brongniartieae (Fabaceae), a tribe that also includes a few Central and South American genera. *Cristonia* was recently described (Ross 2001) to accommodate *Cristonia biloba* (Benth.) J.H.Ross, a species previously placed in *Templetonia* R.Br. and endemic to south-western Western Australia. *Cristonia* is distinguished from other genera in the tribe by a combination of features including apically bilobed leaves, axillary leaves, long-lobed calyces with a brown indumentum and basally cleft arils that have a narrow orifice.

Cristonia appears to be most closely related to *Lamprolobium* Benth. and *Thinicola* J.H.Ross based on both morphological and molecular data (Thompson *et al.* 2001). Their calyx morphology and the fimbriate lower margin of their keels are two features that distinguish them from other genera in the tribe.

Taxonomic history: Only two taxa have ever been described in what is now *Cristonia*. Both were initially placed in *Bossiaea* – *B. biloba* Benth. in 1837 and *B. biloba* var. *stenophylla* Meisn. in 1844. In 1976, Polhill transferred *B. biloba* to *Templetonia*, and in 2001 Ross transferred it to *Cristonia*. In neither instance was Meissner's variety considered worthy of formal recognition. However, in the current study, the pattern of morphological variation elucidated for *Cristonia* calls for its recognition as a species. Furthermore, it is considered that a third entity should be recognised at the rank of subspecies.

Methods

The pattern of morphological variation in *Cristonia* as reflected in the taxonomy presented below was identified through examination of herbarium material with the aid of a dissecting microscope. Assessment of floral morphology was aided by the reconstitution of dried flowers in hot water with added detergent. Specimens from CANB, MEL and PERTH were examined.

In *Cristonia*, taxonomically useful characters recognised in this study include: frequency of occurrence, size and number of axillary leaves;

shape, indumentum pattern and tubercle size of leaves; dimensions of the calyx and corolla; size of pods and seeds; and size and smoothness of the aril.

Taxonomy

Cristonia J.H.Ross, *Muelleria* 15: 9 (2001)

Type: *Cristonia biloba* (Benth.) J.H.Ross.

Erect subshrubs to c. 0.5 m high, taprooted, single-stemmed. *Indumentum* dense on younger branches, pedicels, bracts, bracteoles and calyces, variably dense on leaves, greyish to brown depending on organ, brownest on pedicels and calyces; hairs simple, fairly straight, brown basally, becoming white distally, generally antrorse-appressed. *Branches* moderately divergent to sub-erect, terete to slightly angular, with a whitish waxy coating evident when hairs lost; 1 or 2 axillary leaves smaller than subtending leaf often developed at lower- to mid-branch nodes, with a leaf-cluster sometimes additionally present. *Leaves* alternate, mostly sub-erect, simple, short-petiolate; lamina variable in shape, attenuate to cuneate basally, apiculate, sometimes enlarged and bilobed distally with lobes angled forwards; surfaces variably hairy, commonly glabrescent; estipulate. *Inflorescences* axillary, arising from a few to several successive nodes towards terminus of branches, with 1 or 2 flowers per axil; bract and bracteoles persistent, oblong-lanceolate, bract basal or near-basal; bracteoles inserted slightly below receptacle. *Calyx* persistent in fruit, brown to greyish externally, slightly fleecy internally; tube much shorter than lobes, upper lobes broader than lower, fused to form a ±oblong lip with apex more or less truncate, notched with sinus shallow; lateral lobes subequal to medial lobe; petals all of similar length, or wings a little shorter; standard yellow with purple-brown flare surrounding a greenish-yellow throat; wings predominantly purple-brown externally, yellow nearer margins; keel pale yellow-green, rarely tinged purple, margin minutely fimbriate; stamens all fused to form an adaxially open sheath; anthers alternately basifixed and dorsifixed, with basifixed anthers c. 1.5 times longer than dorsifixed anthers; ovary glabrous, 4–6-ovulate; stigma conspicuously capitate. *Pods* short-stipitate, moderately compressed, base broad-cuneate, surface undulating in correspondence with internal partitioning. *Seeds* ellipsoid, plump, body 4–5 mm long, brown, not mottled; hilum subapical; aril wall rather thick and deep, smooth or crenate, with a vertical lobe arising from one side, cleft at end nearest the lens, orifice c. 0.1 mm wide.

Distribution: *Cristonia* occurs in a band extending from Kalbarri in the north to the Perth region in the south, and mostly within 150 km of the west coast of southern Western Australia (west of longitude 116°30′ E).

Notes on morphology: LEAVES (Fig. 1). There is usually a slight change in size and shape of leaves between the base and termini of branches, with leaves generally shorter and more cuneiform nearer the base. There is also a moderate amount of variability within and between species in shape, including the distal lobation. A distinctive feature of *Cristonia* is the development of one or more often a pair of axillary leaves at some nodes (Fig. 1, a–d). Their placement, which is permanent, makes them resemble a pair of leafy stipules, and the overall arrangement of main leaf and axillary leaves is also reminiscent of the trifoliolate leaves in *Plagiocarpus* Benth., another Australian member of the Brongniartieae. A clustering of additional basal leaves also occurs in axils in *Cristonia biloba* (Fig. 1d). This clustering effect will be lost when the branch on which the leaves are inserted elongates. Some nodes have been observed where a pedicellate flower arises from one side of the leaf and an axillary leaf arises from the other side. This development of a pair of axillary leaves is also seen in *Hovea acanthoclada* (Turcz.) F.Muell., and in this species they are generally larger than the subtending leaf. The bract subtending a pedicel, although most resembling the bracteoles in size (Fig. 2a), are occasionally enlarged and greenish and reminiscent of these axillary leaves

The upper surfaces of leaves are initially hairy and each hair arises from a low tubercle. Hairs are generally soon lost, but close inspection often reveals a hair remnant persisting at the summit of these tubercles. The prominent tubercles at the leaf apex in *C. biloba* subsp. *biloba* distinguish it from the other two taxa.

FLOWERS (Figs 2a–d): Flower morphology is very similar in all taxa, although *C. stenophylla* generally has smaller flowers, and the extent of purple pigmentation of the wings is greater in *C. biloba* subsp. *biloba* (Figs 2c

Figure 1. Branches and leaves. a–c. Leaves along branch. a *Cristania stenaphylla* (single small axillary leaves evident near bottom *af* picture; *J.H. Rass 4093* MEL); b. *C. bilaba subsp. bilaba* (*H. Bawler 390* PERTH); c. *C. bilaba* subsp. *pubescens* (*E.A. Griffin 877* PERTH). d. *C. bilaba* subsp. *bilaba*, close-up *af* nade: main leaf angled to left, axillary leaf at 90° ta main leaf, leaves of axillary cluster directed vertically (*J.H. Rass 3832* MEL);. e–i. Leaf apices. e. *C. bilaba* subsp. *bilaba*, upper surface (*N.H. Speck*, 3.vii.1952 PERTH); f–i (lower surface): f. *C. biloba* subsp. *bilaba* (*G.J. Keighery 4990* PERTH); g. *C. stenaphylla* (*R.D. Royce 6456* PERTH). h. *C. bilaba* subsp. *biloba* (*H. Bawler 390* PERTH); i. *C. bilaba* subsp. *pubescens* (*A.J. Lin 44* PERTH). Scale bars: a–c = 5 mm; e = 2 mm; d, f–i = 1 mm.

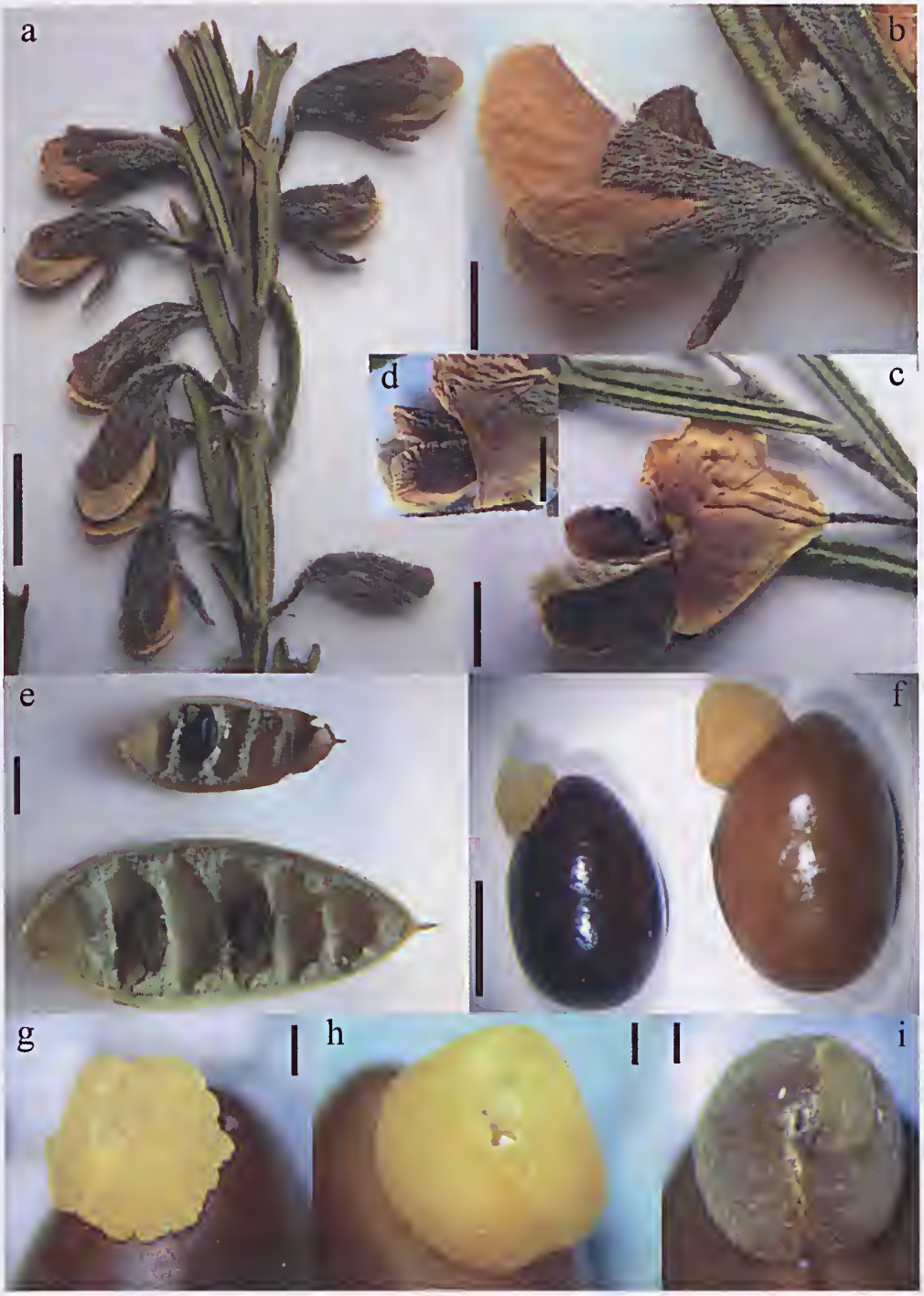

Figure 2. Flowers, fruits and seeds. a. Flowering branch (*R.J. Cranfield R28* PERTH). b–d. Flowers. b. *Cristonia stenophylla* (*N. Sammy* 15 Aug. 1985 PERTH); c. *C. biloba* subsp. *biloba* (*G. Smith 23* PERTH); d. *C. stenophylla* (*P. Armstrong S48* PERTH). e. Pod valves (inside view): top, *C. stenophylla* (*B. Smith 245* PERTH) & bottom, *C. biloba* subsp. *biloba* (*J.H. Ross 3832* MEL); f–i. Seeds. f. left, *C. stenophylla* (*coll. unknown*, MEL 664680) & right, *C. biloba* subsp. *biloba* (*J. Sewell*, 1888 MEL); g. *C. stenophylla*, aril (*coll. unknown*, MEL 664680), h. *C. biloba* subsp. *biloba*, aril (*J. Sewell*, 1888 MEL), i. *C. biloba* subsp. *pubescens*, aril (*E.A. Griffin 673* PERTH). Scale bars: a = 10 mm; b–e = 5 mm; f = 2 mm; g–i = 0.5 mm.

Key to species

Note: Select younger leaves when assessing indumentum.

1: Pods 6–9 mm wide; aril 1.3–1.5 mm in diameter, with wall crenate; lower- to mid-branch nodes sometimes with 1 or 2 axillary leaves to 5 mm long, but without additional leaves clustered; hairs evenly scattered over lower surface of leaves; upper-branch leaves generally not or hardly dilated apically ..... **1. *C. stenophylla***

1 Pods 9–14 mm wide; aril 1.8–2.5 mm in diameter, with wall entire; lower- to mid-branch nodes usually with 2 axillary leaves to 20 mm long and often also with additional leaves clustered; hairs not evenly scattered over lower surface of leaves (usually localised to midrib) or if so then leaves markedly dilating apically ..... **2. *C. biloba***

& 2d). The keel in *Cristonia* has a fimbriate lower margin, a feature also seen in *Thinicola* and *Lamprolobium*. Plants with yellow-petalled flowers have been noted by collectors.

PODS AND SEEDS (Figs 1a, 2e–i): The location of the cleft in the aril at the basal end distinguishes *Cristonia* from other genera in the tribe with the exception of *Plagiocarpus* in which some species display this feature to some extent.

1. *Cristonia stenophylla* (Meisn.) I.Thomps., *comb. et stat. nov.*

Bossiaea biloba var. *stenophylla* Meisn., *in* J.G.C. Lehmann, *Pl. Preiss.* 1: 85 (1844).

***Type*:** Western Australia. Swan River, *J. Drummond 264*; holo: W (right-hand specimen), photo seen MEL 2120315; iso: MEL 501184.

Erect subshrubs to c. 0.6 m high, with subtuberous taproot. *Stems* to c. 2 mm in diameter; 1 or 2 axillary leaves to c. 5 mm long sometimes developed; axillary leaf-clusters not developed. *Leaves* sometimes caducous below mid-branch; petiole c. 1 mm long; basal and lower-branch leaves with lamina cuneate to linear-cuneate, to c. 30 mm long, to c. 8 mm wide, sometimes dilated apically with sinus to 2 mm deep; mid- to upper-branch leaves with lamina narrow-linear, 3–5 mm wide, 20–70 mm long, 1–4 mm wide mid-leaf, not dilating at apex or dilating by up to 1 mm; base attenuate; margin strongly revolute; apex rounded or truncate or occasionally bilobed and/or emarginate, with sinus to 0.8(–1.5) mm deep, sometimes with a triangular medial lobe to 2 mm long arising from sinus; upper surface minutely tuberculate with minute hair remnants sometimes persistent at summit, or more or less smooth; lower surface with scattered loosely appressed hairs, variably glabrescent. *Pedicels* 5–12 mm long; bract 2–3.5 mm long, inserted basally or up to 3 mm distal to base; bracteoles 1.5–2.5 mm long, inserted 1–2 mm below calyx. *Calyx* 6–9 mm long, grey-brown; tube 40–45% of total length; upper lip 3.5–6 mm long, with sinus 1–2 mm deep; petals 10–16 mm long; standard-limb c. orbicular, c. 10–14 mm wide, with flare c. 2 mm wide, claw c. 3 mm long; wings often slightly shorter than keel, 4–5 mm wide, with pale margin up to c. 1 mm wide, claw c. 3 mm long; keel 4–5 mm deep, claw c. 3 mm long; ovary 4–6-ovulate, with style c. 10 mm long. *Pods* with stipe 1–2 mm long; body ±oblong or oblong-elliptic in profile, 15–25 mm long, 6–9 mm wide, 3–5-seeded; seeds 3.5–4.5 mm long, dark brown to blackish; aril 1.3–1.5 mm in diameter, c. 1 mm tall including lobe, crenate.

***Selected specimens of c. 40 examined*: WESTERN AUSTRALIA.** 32 km from Port Gregory along Yerina Springs Rd, *N. Sammy*, 15.viii.1985 (PERTH); N of Geraldton, *R.D. Royce 6456*, 29.vii.1961 (PERTH); The Brothers, Moresby Ranges, *J. Brooker 45*, 8.vii. 2000 (PERTH); Kalbarri National Park, 200 m N of turn-off to Z-bend and the loop, 11 km NE of Kalbarri on Kalbarri–Ajana Rd, *J.H. Ross 4093*, 17.ix. 2000 (MEL 2105438); 37 km W of Coorow, *R.J. Cranfield 267*, 21.vii.1978 (CANB, PERTH); 27 km E of Murchison River mouth, *M.E. Phillips*, 27.ix.1962 (CANB).

***Distribution and habitat*:** Occurs in south-western Western Australia from Bolgart north to Kalbarri with all but the Bolgart record being north of Coorow (Fig. 3a). The distribution of *C. stenophylla* does not overlap that of *C. biloba*. Grows in white or grey sands, or red-brown clayey sand in heathland and shrubland.

***Flowering period*:** Flowers June to July.

***Notes*:** *Cristonia stenophylla* appears less leafy than *C. biloba* due to the smaller axillary leaves and lack of axillary clusters, and flowers, fruits and seeds are

Key to subspecies of *Cristonia biloba*

1 Lower surface of leaves mostly glabrous either side of midrib; upper-branch leaves becoming parallel-sided approaching zone of dilation; upper surface of leaves prominently tuberculate at apex of lobes; wings purple-brown virtually to the apex ..... **2a.** subsp. ***biloba***

1: Lower surface of leaves with hairs evenly distributed throughout; upper-branch leaves cuneate to zone of dilation; upper surface of leaves inconspicuously tuberculate; wings mostly purple-brown but distal millimetre yellow ..... **2b.** subsp. ***pubescens***

smaller. Compared to *C. biloba* subsp. *biloba* the upper surface of the leaf is less prominently tuberculate distally. However, *C. biloba* subsp. *pubescens* is similar to *C. stenophylla* in this respect. A specimen from Murchison River (Phillips CANB) is atypical in having upper-branch leaves lobed distally. However, in these leaves the apical sinus is not particularly deep and the amount of dilation is small, and in other respects the specimen conforms well with *C. stenophylla*. In some specimens of *Cristonia stenophylla*, hairs have been noted arising from veins of the keel close to the lower margin.

2. *Cristonia biloba* (Benth.) J.H.Ross, *Muelleria* 15: 11 (2001)

Bossiaea biloba Benth., *in* S.L.Endlicher *et al.*, *Enum. Pl.* 36 (1837); *Templetonia biloba* (Benth.) Polhill, *Bot. Syst.* 1: 309 (1976).

***Type*:** Western Australia. Locality unknown [Given as King Georges Sound but unlikely to be from this locality], *Hügel*; holo: W *n.v.*, photo MEL 2092155.

Erect subshrubs to c. 0.6 m high, with roots not seen; with rootstock extending progressively each year. *Stems* to c. 3 mm in diameter; a pair of axillary leaves to c. 20 mm long usually developed at lower to mid-branch nodes; axillary leaf-clusters usually also developed. *Leaves* generally persistent; petiole c. 1 mm long; basal and lower-branch leaves with lamina cuneate to linear-cuneate, to 15 mm long, to c. 8 mm wide, with apex truncate or bilobed apically with sinus to 5 mm deep; mid- to upper-branch leaves with lamina narrow-oblong to linear or oblanceolate up to lobes, 10–30 mm long, 1–4 mm wide mid-leaf, often bilobed apically and up to 6 mm wider than midleaf, sometimes not bilobed; base narrow-cuneate; margin nearly flat, recurved or revolute; apical sinus to 5 mm deep, sometimes a triangular lobe to c. 2 mm long, arising from sinus; apiculum commonly triangular; upper surface tuberculate, with tubercles minute to conspicuous, lower surface with hairs restricted to midrib or widespread. *Pedicels* 4–12 mm long; bract 2–5 mm long, inserted basally or up to 3 mm distal to base, sometimes with apex recurved; bracteoles 1–2 mm long, inserted 1–2 mm below calyx. *Calyx* 8–12 mm long, brown, or occasionally grey-brown; tube c. 1/3 of total length; upper lip 5–8 mm long, with sinus 1–2.5 mm deep; petals 12–18 mm long; standard-limb c. orbicular, c. 12–18 mm wide, with flare c. 3 mm wide, claw 4–5 mm long; wings c. as long as keel, 4–7 mm wide, purple-brown more or less throughout, or becoming yellow distally and/or along lower margin, claw 2–3 mm long; keel 4–6 mm wide, claw 2.5–3.5 mm long; ovary 3–6-ovulate, with style c. 10 mm long. *Pods* ±oblong or oblong-elliptic in profile, 15–35 mm long, 9–14 mm wide, 3–5-seeded; seeds 4–5.5 mm long, mid-brown; aril 1.8–2.5 mm in diameter, 1.5–2 mm tall including lobe, smooth.

2a. *Cristonia biloba* subsp. *biloba*

Leaves of mid to upper branches oblong or oblong-cuneiform below the dilation; apex sinus varying from slightly broader than deep to much deeper than broad; lower surface with hairs restricted to midrib or occasionally partially laterally. *Pedicels* to 12 mm long. *Wings* 4–5 mm wide, with purple-brown pigmentation reaching more or less to apex; keel 4–5 mm wide. *Seeds* 4.5–5.5 mm long, with aril 2–2.5 mm in diameter, with lobe c. 1 mm high.

***Selected specimens of c. 100 examined*: WESTERN AUSTRALIA.** Adjacent ACTIV industries, High Wycombe, *M. Hislop 1059*, 6.vi.1998 (PERTH); Helena River, Mundaring, *C.A. Gardner 538*, 10.vii.1920 (PERTH); Ellis Brook Valley reserve, *H. Bowler 390*, 27.vi.1999 (PERTH); Piesse Brook, intersection of Mundaring Weir Rd and Aldersyde Rd, 12.4 km SW of Mundaring, *J.H. Ross 3832*, 24.xi.1996 (MEL 2043459); Darling Range escarpment, Susannah Brook, *M.G. Corrick 9934*, 31.vii.1986 (MEL 1555244); Greenmount, Perth, *J.A. Chappill s.n.*, 29.xi.1991 (MEL 2010155); Helena Valley, *J. Seabrook 29*,

3.vii.1977 (PERTH); Junction of Perth to Toodyay and Dalgetty Rds, *B.H. Smith 1723*, 16.vii.1994 (MEL 2023375); Midland Junction, Swan River, *A. Morrison 10425*, 6.vi.1900 (CANB)

***Distributian and habitat*:** Occurs in the far west of south-western Western Australia between 30° and 33°S from Hill River–Badgingarra area south to the Perth area (Fig. 3b). Grows in sand and sandy-loams in eucalypt woodland.

***Flawering periad*:** Flowers winter.

***Nates*:** Generally a more densely leafy species than *C. stenophylla*. Some specimens have leaves that are mostly not markedly bilobed, particularly the smaller more basal leaves of a branch. Although there is possibly a genetic component to this variation, it is more likely to be due to poorer quality soils.

A specimen from Hill River (*N.H.Speck* 3 July 1952 PERTH), which is within the distribution of subsp. *pubescens*, is tentatively identified as subsp. *biloba* as its leaves have hairs restricted mainly to the midrib on the lower surface. Its leaves have an unusual sharply V-shaped sinus (Fig. 1e). The flowers are inadequate to ascertain the wing pigmentation.

The three specimens used for illustration by Ross (1982) have all been determined as subsp. *biloba*. The representation of leaves as cuneiform throughout in these illustrations is inaccurate.

2b. *Cristonia biloba* subsp. *pubescens* I.Thomps., *subsp. nov*.

A subspecie typica foliis cuneiformis infra lobi, pagina inferiore foliorum pubescenti, alis luteis apicem versus differt.

***Type*:** Western Australia. Western Titanium Leases, 7 km S of Eneabba, *E.A. Griffin 877*, 10.vii.1976; holo: PERTH.

Leaves of mid to upper branches cuneiform below the dilation, with width at base of dilation 25–50% wider than width mid-leaf, apex sinus generally markedly broader than deep; lower surface evenly covered with hairs. *Pedicels* to 7 mm long. *Wings* 5–7 mm wide, purple-brown becoming yellow in distal 1 mm; keel 4.5–6 mm wide, pale, often with a purple tinge distally and adjacent to upper margin. *Seeds* 4–4.5 mm long (but possibly not full size); aril lobe 0.4 mm high, with a shallow groove present at junction of lobe and wall laterally.

***Specimens examined*: WESTERN AUSTRALIA.** Western Titanium leases 8 km S of Eneabba, *E.A. Griffin 673*, 20.x.1976 (PERTH); Lesueur National Park, N/S Peron seismic line, junction first E-W track to S of Peron, *B. Evans 633*, 20.vi.1993 (PERTH); 200 m W from The View Drive, Mullering Rd, Dandaragan, *A.J. Lin 44*, 4.vii.2003 (PERTH).

***Distribution and habitat*:** Occurs in near-coastal western Western Australia between Eneabba and Dandaragan (Fig. 3c). There is some overlap with the distribution of subsp. *biloba*. Grows on brown sandy loam over laterite and grey and white sands over clay, in shrubland and heathland.

***Flawering periad*:** Flowers winter.

***Etymalagy*:** The epithet refers to the hairiness of the lower surface of the leaves (L. *pubescens*, hairy).

***Notes*:** Although based on only four collections,

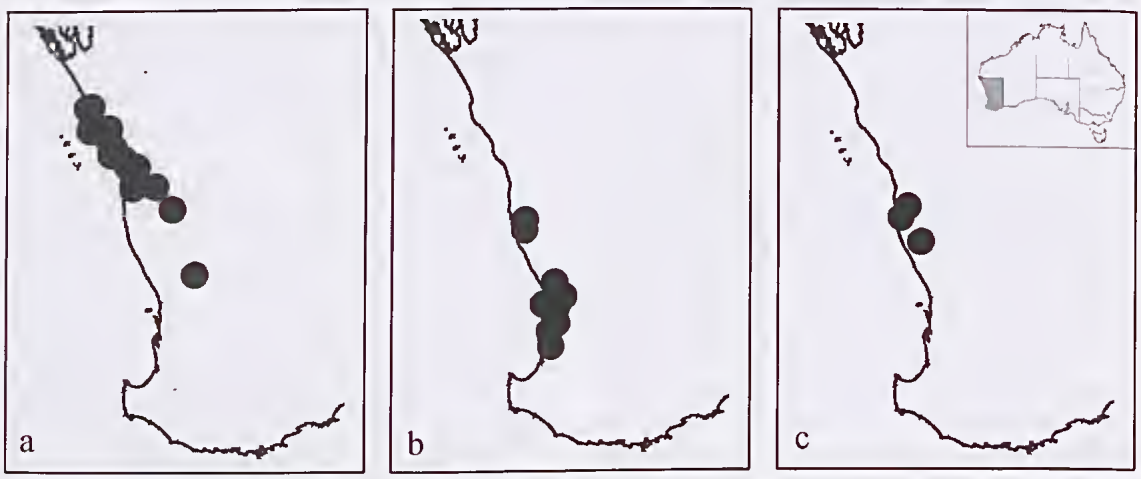

Figure 3. Distributions. a. *Cristonia stenophylla* b. *C. biloba* subsp. *biloba* c. *C. biloba* subsp. *pubescens*

there are sufficient differences, particularly in leaf shape and indumentum and seed characters, to warrant recognition at subspecies level. Further collections are desirable. Only one fruiting specimen exists, from Eneabba (*E.A. Griffin* 673 PERTH), and in this the pod partitions have a different texture to that of the type subspecies, and the arils of the seeds have a smaller lobe. A difference in colour may be due to slight immaturity (Fig. 2).

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References

Polhill, R.M. (1976), Genisteae (Adans.) Benth. and related tribes (Leguminosae). In V.H.Heywood (ed.), *Botonicol Systematics*, vol. 1, pp. 143–368, Academic Press, London.

Ross, J.H. (2001). Two new endemic Australian genera in the Tribe Brongniartieae (Fabaceae) to accommodate two species formerly included in *Templetonia* R.Br. *Muellerio* **15**, 7–14.

Thompson, I.R., Ladiges, P.Y. and Ross, J.H. (2001). Phylogenetic Studies of the Tribe Brongniartieae (Fabaceae) using nuclear DNA (ITS-1) and Morphological Data. *Systemotic Botony* **26**, 557–570.

Definition of South Pacific taxa of *Nicotiana* section *Suaveolentes* (Solanaceae) a 2594347

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Abstract

The taxonomy of South Pacific species of *Nicotiana* requires clarification. Examination of type and other herbarium specimens supports recognition of three species: *N. forsteri* Roem. & Schult., *N. fragrons* Hook., and *N. fotuhivensis* F.Br. *Nicotiano forsteri* is synonomised with *N. debneyi* Domin. In agreement with previous authors, *N. forsteri* is considered to be validly published and the name takes precedence over *N. debneyi*. Plants from the Marquises Islands are distinct from *N. fragrons* Hook., and thus are recognised at species level as *N. fotuhivensis* F.Br. rather than *N. frogrons* var. *fotuhivensis* (F.Br.) Goodsp. *Nicotiana fotuhivensis* is treated as a member of section *Suoveolentes* Goodsp., not section *Paniculotoe* Goodsp., but more data are required to resolve its relationships. Key features for discriminating taxa are the presence of a caudex, ellipsoid-headed glandular hairs and flower size.

Keywords: taxonomy, species, Australia, New Caledonia, Marquesas Islands.

Muellerio 28(1): 74-84 (2010)

Introduction

In terms of species, *Nicotiana* section *Suaveolentes* Goodsp. is a somewhat taxonomically difficult group. Although there are some species that are clearly defined, distinctive and present no taxonomic or identification problems, others are difficult to separate and identify. The section *Suaveolentes* is monophyletic (Aoki & Ito 2000; Chase *et al.* 2003; Clarkson *et al.* 2004) and was retained in the recent sectional classification (Knapp *et al.* 2004). Intrieri *et al.* (2008) suggest the section is polyphyletic but their analyses are phenetic and not phylogenetic.

The aim of this paper is to address species and subspecies level taxonomic problems and to redefine taxa where appropriate. Many invalid names for Australian *Nicotiana* are still widely used, such as *N. eastii* Kostoff and *N. exigua* H.-M.Wheeler, particularly in molecular studies published outside of Australia (Table 1). This may be caused partly by lack of awareness of publications in Australian journals not widely available overseas; for example Horton's comprehensive 1981 revision was published in the Journal of the Adelaide Botanic Gardens.

Nicotiana plants are not widespread in the South Pacific and have a patchy distribution (Fig. 1). *Nicotiana fatuhivensis* F.Br. is found only on eight of the twelve Marquesas Islands, a group of isolated volcanic islands that form part of French Polynesia, located in the east central Pacific at approximately 8–10° S and 140° W. *Nicotiana fragrans* Hook. has been recorded on the island of Tongatapu, part of the Kingdom of Tonga, at approximately 21° S and 175° W, as well as almost 2000 km further west on several islands of New Caledonia (approximately 21° S and 165° E). The third South Pacific taxon, *N. debneyi* Domin, is found on New Caledonia, Lord Howe Island 600 km from the Australian mainland (31°30˝ S, 159° E) and in eastern Australia. *Nicotiana cordifolia* Phil., which belongs to section *Paniculatae*, is endemic to the eastern Pacific Juan Fernandez Islands, a group of volcanic islands about 667 km from the coast of Chile. It is clearly associated with South American taxa and is not discussed here.

Outstanding taxonomic issues and poorly known taxa have combined to make the South Pacific *Nicotiana* the most problematic members of section *Suaveolentes*. The two most recent revisions of the Australian taxa (Burbidge 1960; Horton 1981) did not include South

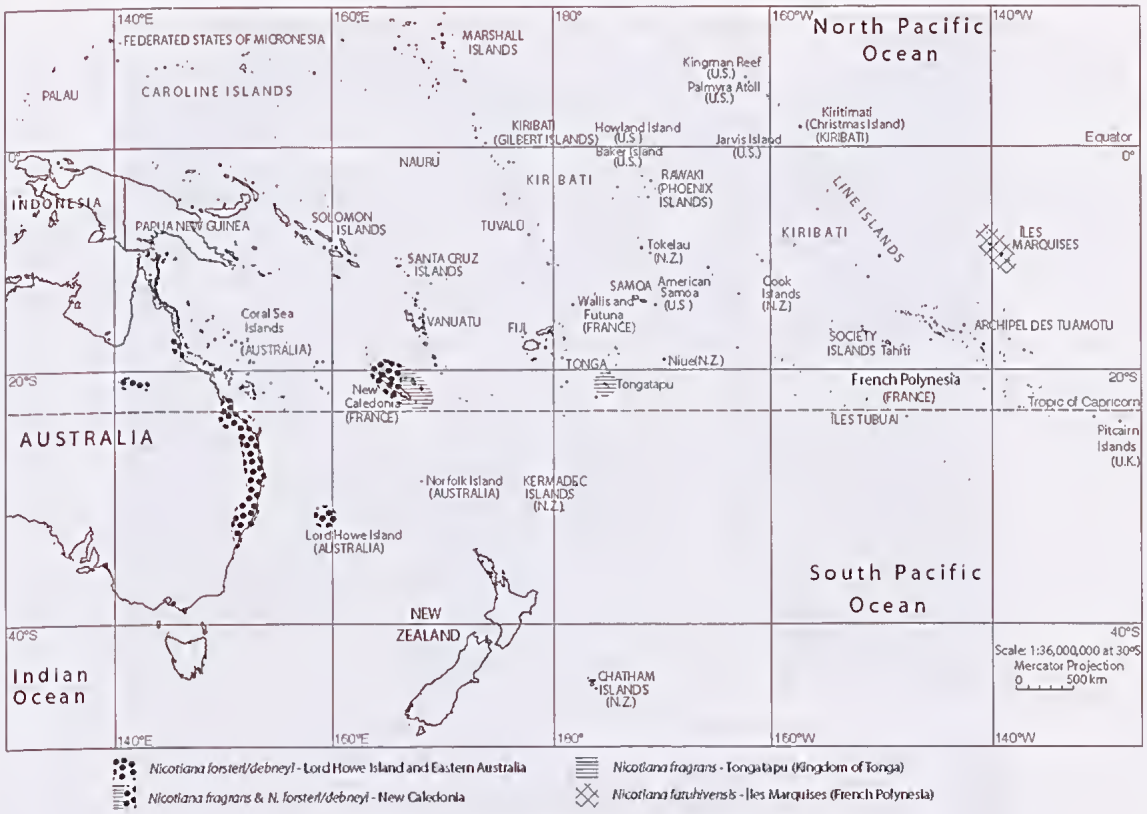

Figure 1. Distribution of *Nicotiana* taxa of the South Pacific.

Pacific taxa, making Goodspeed (1954) the most recent revision that includes all taxa in *Suaveolentes*. These species have been less well collected than those of the rest of the genus, and herbarium sheets that do exist are spread between distant herbaria.

South Pacific taxa are not well represented in molecular studies. *Nicotiana fragrans* (New Caledonia and Tonga) was included in two molecular phylogenies (Aoki & Ito 2000; Chase *et al.* 2003) but was not included in a recent and comprehensive study by Clarkson *et al.* (2004). There are no published sequences of *N. fatuhivensis* (Marquesas Islands) and the provenance of the *N. debneyi* specimen that was sequenced is not listed, and therefore it could be Australian or from New Caledonia.

The published chromosome number for *N. debneyi* (Goodspeed 1933) and *N. fragrans* is n=24 (Wheeler 1945), although unfortunately the provenance of the plants used for these counts is not known. These numbers fit within the n=16, 18, 19, 20, 21, 23, 24 sequence reported for section *Suaveolentes*. A chromosome number has not been published for *N. fatuhivensis* or *N. forsteri* Roem. & Schult.

In summary, the specific taxonomic questions addressed are:

1) Is *N. forsteri* Roem. & Schult. (New Caledonia) a separate species, or is it the same as *N. debneyi* (Australia) or *N. fragrans* (New Caledonia)?

2) Was *N. forsteri* validly published and should the name take precedence over *N. debneyi*?

3) Is *N. fatuhivensis* different from *N. fragrans*? Should *N. fatuhivensis* be maintained as a species or as a variety of *N. fragrans*?

Materials and methods

Herbarium material, including type specimens, was examined in August 2006 at the New York Botanical Garden (NY), at the Royal Botanic Gardens, Kew (K) and the Natural History Museum, London (BM). Specimens were examined using a light microscope to determine hair types, and vernier callipers were used to make key measurements of flowers, capsules and leaves. Measurements included corolla tube length, width at apex and at calyx; calyx length, width and length

Figure 2. Specimens of *Nicotiana*. **a.** *N. forsteri*, type, *J.R. & G. Forster*, 29–30.ix.1774, Botany Isle, New Caledonia (BM) © The Natural History Museum, London. **b.** *N. fragrans*, type, *Milne*, x.1853, Isle of Pines, New Caledonia (K). **c.** *N. fatuhivensis*, *P.A. Schafer 5705*, 19.viii.1975, Mohotani Island, Marquesas Islands (K). **d.** *N. debneyi*, type, *J. Dallachy*, 1868, Rockingham Bay, Queensland, Australia (K). **b, c, &d.** © The Board of Trustees of the Royal Botanic Gardens, Kew. Reproduced with the consent of the Royal Botanic Gardens, Kew.

Table 1. *Nicotiana* taxa in section *Suaveolentes*. Those marked Y have been included in published molecular studies. A = Aoki and Ito (2000), B = Chase *et al.* (2003), C = Clarkson *et al.* (2004). Nine taxa have not been included in any molecular studies: *N. burbidgeoe*, *N. fotuhivensis*, *N. heterantho*, *N. megolosiphon* ssp. *sessifolio*, *N. monoschizocorpo*, *N. occidentolis* ssp. *obliquo*, *N. truncoto*, *N. wuttkei*, and *N. sp. Corunno (D.E.Symon 17088)*. Other molecular phylogenies with only minimal sampling of the *Suaveolentes* include: Olmstead *et al.* 2008, three taxa; Komarnitsky *et al.* 1998, eight taxa but minimal resolution.

Taxa	Name history	A	B	C
N. africana Merxm.	current		Y	Y
N. amplexicaulis N.T.Burb.	current	Y	Y	Y
N. benthamiana Domin	current	Y	Y	
N. burbidgeae Symon	current			
N. cavicola N.T. Burb	current	Y	Y	Y
N. debneyi Domin	current - syn. N. forsteri Roem. & Schult.	Y	Y	Y
N. excelsior (J.M.Black) J.M.Black	current		Y	
N. fatuhivensis F.Br.	current			
N. fragrans Hook.	current	Y	Y	
N. goodspeedii H.-M.Wheeler	current		Y	Y
N. gossei Domin	current	Y	Y	Y
N. heterantha Symon & Kenneally	current			
N. maritima H.-M.Wheeler	current		Y	Y
N. megalosiphon Van Heurck & Mull.Arg. subsp. megalosiphon	current	Y	Y	Y
N. megalosiphon Van Heurck & Mull.Arg. subsp. sessifolia P.Horton	current			
N. monoschizocarpa (P.Horton) Symon & Lepschi	current			
N. occidentalis H.-M.Wheeler subsp. hesperis (N.T.Burb.) P.Horton	current		Y	
N. occidentalis H.-M.Wheeler subsp. obliqua N.T.Burb.	current			
N. occidentalis H.-M.Wheeler subsp. occidentalis	current		Y	Y
N. rosulata (S.Moore) Domin subsp. ingulba (J.M.Black) P.Horton	current		Y	
N. rosulata (S.Moore) Domin subsp. rosulata	current		Y	
N. rotundifolia Lindl.	current		Y	Y
N. simulans N.T.Burb	current	Y	Y	
N. suaveolens Lehm.	current		Y	Y
N. truncata Symon	current			
N. umbratica N.T.Burb.	current	Y	Y	
N. velutina H.-M.Wheeler	current		Y	Y
N. wuttkei J.R.Clarkson & Symon	current			
N. sp. Corunna (D.E.Symon 17088)	unpublished possible new species			
N. eastii Kostoff	invalid		Y	
N. exigua H.-M.Wheeler	not current – syn. N. suaveolens	Y	Y	Y
Totals	29 current taxa, one possible new species	10	22	13

of calyx tube; corolla limb width; capsule length and width; leaf length and width; petiole length and width of winged petiole and basal auricles. Note was also made of leaf tip and base shape, corolla lobe shape, and seed shape and ornamentation.

Is *N. forsteri* (New Caledonia) the same as *N. debneyi* (in Australia) or *N. fragrans* (New Caledonia)?

Several authors have argued that *N. forsteri* and *N. debneyi* are synonymous (Wheeler 1935; Goodspeed 1954; Green 1994), however, Heine (1976) synonymised *N. forsteri* with *N. fragrans*. The specimens of these three species have been examined and are summarised in Table 2. Photographs of the specimens are shown in Figure 2.

From examination of these type specimens it appears most likely that *N. forsteri* and *N. debneyi* are synonymous and *N. fragrans* is a distinct entity. There are four key characters:

1) *N. fragrans* has a distinct caudex, or woody perennial base. The base of the stem and roots of *N. forsteri* and *N. debneyi* are not shown, but from the stems that are present it seems unlikely that they are woody at the base. Other authoritatively determined specimens and plants of *N. debneyi* that I have seen do not form a caudex.

The woody caudex is an adaptation to a specialised ecological niche: for *N. fragrans*, this niche is fissures in seaside rocks. A photograph of *Nicotiana fragrans* growing in a littoral volcanic rockfield in New Caledonia is shown in Figure 3. From *Flore de la Nouvelle-Calédonie et Dépendances* (Heine 1976) it is clear that *N. fragrans* is only found on seaside rocks and cliffs, often of limestone composition, sometimes in the spray zone alongside other halophyte vegetation. In New Caledonia *N. debneyi* is found growing on sandy beaches, sedimentary sands, and in sandy ground just above the beach (Heine 1976).

2) Both the specimens of *N. forsteri* and *N. debneyi* have ovate to elliptic, subpetiolate, auriculate cauline leaves. This auriculate, stem-clasping character was a key part of both type descriptions and is clearly lacking in *N. fragrans*. The type specimen of *N. fragrans* has distinctly spathulate leaves with narrowly winged petioles as per Hooker's description.

3) *N. debneyi* and *N. forsteri* have smaller flowers than *N. fragrans*. The measurements taken from the *N. fragrans* specimen fit within Goodspeed's (1954) description of the corolla tube as 40–100 mm long, and the types of both *N. forsteri* and *N. debneyi* fit within Goodspeed's description of *N. debneyi* as having a corolla tube 15–21 mm long.

4) The presence of ellipsoid-headed glandular hairs is an important character for defining taxa within *Suaveolentes*. *Nicotiana debneyi, N. forsteri, N. occidentalis* H.-M.Wheeler, *N. umbratica* N.T.Burb. and *N. cavicola* N.T.Burb. all have these distinctive hairs with dark, ellipsoid, multicellular glands. The fact that *N. forsteri* and *N. debneyi* have these hairs and the type of *N. fragrans* does not, is compelling evidence for the *N. forsteri* type to be associated with *N. debneyi*.

A survey of the taxonomic literature reveals marked similarities between descriptions of *N. debneyi* based predominantly on Australian specimens (Wheeler 1935; Goodspeed 1954; Horton 1981; Purdie *et al.* 1982), with the *N. forsteri* description (Green 1994) based on Lord Howe Island specimens, and the *N. debneyi* description (Heine 1976) based on New Caledonian specimens (Table 3). There is also concordance of key traits such as corolla tube length between the descriptions of *N. fragrans* by Wheeler (1935), Goodspeed (1954) and Heine (1976) based on New Caledonian only or New Caledonian and Tongan collections (Table 4). All descriptions of *N. debneyi/forsteri* note the auriculate bases of the cauline leaves, a feature which is not found in any descriptions of *N. fragrans*. Heine (1976), Green (1994) and Goodspeed (1954) also note the unusual (for the section) pink or purple flushing of the corolla tube in *N. debneyi/forsteri*, which has been observed by the author for Australian plants, and which has never been documented for *N. fragrans*. The corolla limb lobes are held diagonally in *N. debneyi/forsteri*, with upper lobes flaring back towards the tube and the lower larger lobes projected forwards. In *N. fragrans* the corolla lobes are equal and actinomorphically spreading. This character is impossible to judge from herbarium specimens but various authors have described or illustrated this feature (Tables 3 and 4). *N. fragrans* has leaves clustered at the apex of the caudex and at the base of each scape, whereas *N. debneyi/forsteri* has some radical and some cauline leaves. These descriptions add further weight to the argument for synonymy of *N. debneyi* and *N. forsteri* and the separation of *N. fragrans*.

Was *N. forsteri* validly published and should the name take precedence over *N. debneyi*?

The name *N. debneyi* has until recently been

Table 2. Observations and measurements of three *Nicotiana* specimens. The specimens are: *Nicotiana debneyi* Domin (*J. Dallachy*, Rockingham Bay, Queensland, K), *N. forsteri* Roem. & Schult. (J.R. & G. Forster, Botany Isle (Île Améré), New Caledonia, BM) and *N. frograns* Hook. (*J. McGillivray*, Isle of Pines, New Caledonia, K). The type of *N. frograns* (*Milne*, x.1853, Isle of Pines, New Caledonia, K) has damaged flowers so another specimen from the same voyage and locality was used.

Character	*N. debneyi* type	*N. forsteri* type	*N. fragrans*
Caudex present	Not shown, unlikely	Not shown, unlikely	Yes
Ellipsoid headed hairs	Yes	Yes	No
Hair density	Stems moderately hairy at top, sparse at base.	Stems pubescent to base, leaves medium-dense covering of short eglandular or glandular hairs.	Very dense pubescence of long, tangled, white eglandular hairs
Inflorescence	Leafless, many branched.	Leafless, many-branched, stems long and wiry, erect.	Leafless, many branched.
Petioles	Wide wings	Wide wings	Narrow wings
Leaf bases	Broadly auriculate and stem-clasping	Broadly auriculate and stem-clasping	Simple (not auriculate)
Mature leaf length (mm)	220–224	85–150	68–80
Mature leaf width (mm)	69–98	35–70	33–39
Petiole length (mm)	Could not separate	20–50	52–90
Petiole width (mm)	Could not separate	6–10	2.5–3.7
Corolla lobes	unclear	Probably obtuse	Obtuse, slightly emarginate
Floral tube length (mm)	17–19	19–20	72–80
Floral tube width at throat (mm)	3.0	2.2–3.0	5.5–7.0
Floral tube width at calyx (mm)	1.2–1.5	2.0–2.2	2.0–3.0
Calyx length (mm)	5.5–7.0	6.0–7.0	13.0–19.0
Calyx width (mm)	3.0–6.0	2.5–4.5	4.5–6.0

commonly used for all Australian collections, based on Goodspeed (1954), Burbidge (1960) and Horton (1981). However, Green (1993) argued that the name *N. forsteri* had been validly published. He considered the two taxa to be synonymous and because *N. forsteri* was the earlier publication, it had priority (Green 1993, 1994). This position to sink *N. debneyi* was supported by Nicolson and Fosberg (2004) but has not been widely accepted. *Nicotiana debneyi*, not *N. forsteri*, was used in the most recent sectional classification (Knapp *et al.* 2004) and in the *Flora of Australia* account (Purdie *et al.* 1982). The Australian Plant Census (Orchard 2006) retains *N. debneyi* based mainly on the strength of recommendation of Dr Sandra Knapp (BM) who 'doubts that the two taxa are indeed the same, and has reservations about the publication of *N. forsteri*'.

So was *N. forsteri* validly published? Roemer and Schultes (1819) list 22 species in the genus *Nicotiana* in Section a. — 'caule arborescente vel fructicoso' or b. —'caule herbaceo'; under the heading 'Dubiae' they list four more species including *N. forsteri*. Neville Walsh (MEL, pers. comm.) advises that this 'doubtful' heading more likely refers to doubt about placement in Sections a or b, rather than it being a doubtful species. The short description is as follows:

23. *N. forsteri*; foliis lanceolatis subpetiolatis amplexicaulibus, floribus acutis, caule frutescente. *N. fructicosa Forst. Floral. Insul. Austr. Prodr. p.17. Lehm. Hist. Nicot. p. 51.* Ipse *Forster* dubitat utrum sua eadem cum *fructicosa Linn. Brown* et *Labillard.* Silent. Videant possessores Herbarii Forsteriani.

(English translation by N. Walsh) *N. forsteri.* with leaves lanceolate, subpetiolate (petiole not fully differentiated from lamina), stem-clasping, flowers acute (probably refers to corolla limb lobes), stem shrubby. Forster himself doubts if it is the same as *fructicosa* L. Brown and Labillardière make no comment. They may have seen the Forster herbarium specimens.

Table 3. Comparison of various authors treatments of *Nicotiana debneyi* and *N. forsteri* based on specimens from mainland Australia, Lord Howe Island and New Caledonia. Attributes important for distinguishing *N. forsteri* and *N. fragrans* (Table 4) are shown.

Author	Wheeler 1935	Goodspeed 1954	Heine 1976	Horton 1981	Purdie et al. 1982	Green 1994
Taxon name	*N. debneyi*	*N. debneyi*	*N. debneyi*	*N. debneyi* ssp. *debneyi*	*N. debneyi* ssp. *debneyi*	N. forsteri
Plant height	to more than 1m	0.5–1.2m	0.5–2.0m	to 0.9(–1.5)m	to 1.5m	to 1(–1.5)m
Caudex present?	—	no (annual)	no (illustration)	no (herb)	no (herb)	no (herb)
Corolla tube length (mm)	15–21	15–21	up to 20	(10–)14–20(–23)	10-25	10–25
Corolla tube width (mm)	2–2.5	2.5 at throat	approx 2.5	1.5–3.0 at top of calyx	1.5–3.0 at top of calyx	—
Corolla tube colour	frequently pink or purple tinged on outside	frequently pink or purple tinged on outer surface	white washed with pink or crimson on outside	—	—	dull purplish red to white
Corolla limb lobe shape	—	short, obtuse subentire or emarginate	broad	broad (often broader than long), obtuse (rarely slightly emarginate)	broad, obtuse	rounded to slightly emaginate
Corolla limb lobes held diagonally?	yes	yes	yes	—	—	—
Leaf length (cm)	23–35	15–35	15–35	(1.5–)3–17(–25)	up to 25	5–20
Some leaves auriculate & +/- stem clasping?	yes	yes	yes	yes	yes	yes
Total specimens cited	11	12	18	18 (total seen 126)	5	5
Mainland Australia	7	9	0	16	5	0
Lord Howe Island	1	1	0	1	0	5
New Caledonia	3	2	18	1	0	0

The type specimen of *N. forsteri* was collected by Forster on Île Améré, or Botany Isle, a tiny islet lying between Grande Terre and the Isle of Pines. Forster referred this type collection, with doubt, to *N. fruticosa* L. (syn. *N. tabacum* L.) in *Florulae insularum Australium prodromus*. (1797, p. 17). Goodspeed (1954) reads Roemer and Schultes as renaming the plant *N. forsteri* 'but again gave the description of *N. fruticosa*, which Forster had taken from Linnaeus'. However, Green (1993) argues that was an intentional description and Neville Walsh (pers. comm.) also supports this view.

From the examination of type specimens (Fig. 2) and the measurements and comparisons made (Table 2) it is reasonable to assert that *N. debneyi* and *N. forsteri* are the same taxon. Given that *N. forsteri* seems to be validly published, and that *N. debneyi* and *N. forsteri* are synonymous, the logical conclusion is that *N. forsteri* is the current, valid name for Australian and New Caledonian plants.

Is *N. fatuhivensis* different from *N. fragrans*? Should *N. fatuhivensis* be a species or a variety of *N. fragrans*?

Nicotiana fatuhivensis is one of the least known, least collected species of *Nicotiana*. It has never been included in molecular analyses (Table 1). The main herbaria with specimens of *N. fatuhivensis* are the National Tropical Botanical Gardens, Kalaheo, Hawaii

Table 4. Comparison of various authors' treatments of *Nicotiana fragrans* based on specimens from New Caledonia and the Kingdom of Tonga. Attributes important for distinguishing *N. forsteri* (Table 3) and *N. fragrans* are shown.

Author	Wheeler 1935	Goodspeed 1954	Heine 1976
Taxon name	N. fragrans	N. fragrans var. fragrans	N. fragrans var. fragrans
Plant height	to over 1m	0.2–1m	0.2–2.0
Caudex present?	no, but notes 'stout base' of Tongan specimen.	yes	yes
Corolla tube length (mm)	55–90	40–100	40–100
Corolla tube width (mm)	3–4	2–3	2–3
Corolla tube colour	—	greenish white	pure white
Corolla limb lobe shape	—	obtuse, slightly emarginate	rounded, slightly emarginate
Corolla limb lobes held diagonally?	—	no (as shown in illustration)	no (as shown in illustration)
Leaf length (cm)	to 15	7–20	up to 20
Some leaves auriculate & +/-stem clasping?	no	no	no
Total specimens cited	7	3	17
New Caledonia	6	2	17
Tonga	1	1	0

(PTBG), the Bishop Museum, Honolulu, Hawaii (BISH) and the Smithsonian Institution, Washington (US). There are no collections of this taxon at BM or in any Australian herbaria. The species was first described by Forest Buffen Harkness Brown (1873–1954) in 1935 and a specimen of *N. fatuhivensis* is shown in Figure 2.

Brown (1935) commented that *N. fatuhivensis* was allied to *N. cordifolia* Phil. of the Juan Fernandez Islands, off the coast of Chile. In 1954 Goodspeed transferred *N. fatuhivensis* to a variety of *N. fragrans* – *Nicotiana fragrans* var. *fatuhivensis* (F.Br.) Goodsp., and placed it within section *Suaveolentes*. It is clear from recent molecular evidence (Chase *et al.* 2003; Clarkson *et al.* 2004) that *N. cordifolia* is closely related to the other six diploid (n=12) South American members of section *Paniculatae* Goodsp. as currently circumscribed (Knapp *et al.* 2004). *Nicotiana fatuhivensis* has never been sequenced, has no published chromosome number and was not included in the recent sectional classification of *Nicotiana* (Knapp *et al.* 2004). No seeds of *N. fatuhivensis* are currently stored at the Millenium Seed Bank, United Kingdom, in the United States Department of Agriculture's National Plant Germplasm System or the Australian Plant Genetic Resources Information System. Based on the limited morphological evidence available *N. fatuhivensis* is treated here as a member of section *Suaveolentes*. Further cytological, molecular and morphological investigation would be highly desirable.

Table 5 summarises a *N. fatuhivensis* specimen at Kew Botanic Gardens (*P.A. Schäfer 5705* 19.viii.1975) in comparison with *N. fragrans*. Unfortunately the type specimen at the Bishop Museum, Hawaii (BISH) has not been seen. A photograph, habitat and an additional herbarium specimen of *N. fragrans* are shown in Figure 3.

The main differences between the specimens are:

1) Location of the leaves. *Nicotiana fragrans* rarely branches and leaves are clustered around the caudex, whereas *N. fatuhivensis* often branches and leaves are clustered at the ends of branches.

2) Leaf shape. *Nicotiana fragrans* has distinctly spathulate or occasionally oblanceolate leaves whereas *N. fatuhivensis* has broadly elliptic leaves.

3) Corolla. The corolla lobes of *N. fragrans* are rounded and obtuse or slightly emarginate, whereas the corolla lobes of *N. fatuhivensis* are mostly acuminate or sometimes acute. The corolla tube of *N. fatuhivensis* is also more slender than *N. fragrans*, especially at the calyx end.

4) Indumentum. *N. fatuhivensis* has ellipsoid glandular hairs whereas *N. fragrans* does not. Leaves and stems of *N. fragrans* are densely covered in long, white, tangled eglandular hairs, whereas leaves and stems of *N. fatuhivensis* are sparsely pubescent to glabrous.

The main similarities between these two taxa are their perennial habit and woody caudex, long corolla tube (compared to other *Suaveolentes*) and occurrence in the South Pacific region. In New Caledonia, *N. fragrans* Hook. is reported to grow on calcareous cliffs (Morat *et al.* 2001), and in a seaside halophytic environment (Jaffré *et al.* 2001) (illustrated in

Table 5. Observations and measurements of *Nicotiana fragrans* and *N. fatuhivensis*. Specimens used: *N. fragrans* Hook. (*J. McGillivray*, x.1853, Isle of Pines, New Caledonia, K), and *N. fatuhivensis* F.Br. (*P.A. Schäfer 5705*, 19.viii.1975, Mohotani Island, K).

Character	N. fragrans	N. fatuhivensis
Caudex present	Yes	Yes
Leaf arrangement	Clustered at apex of caudex	Clustered at ends of branches
Ellipsoid headed hairs	No	Yes
Hairs	Flowers, stems and leaves - very dense pubescence of long, tangled, white eglandular hairs.	Corolla and calyx – dense covering of ellipsoid headed glandular hairs. Stems and leaves very sparsely pubescent to glabrous.
Petioles	Narrow wings	No wings
Leaf bases	Simple (not auriculate)	Simple (not auriculate)
Mature leaf length (mm)	68–80	76–95
Mature leaf width (mm)	33–39	40–51
Petiole length (mm)	52–90	20–29
Petiole width (mm)	2.5–3.7	
Corolla lobes	Obtuse, slightly emarginate	Acute, acuminate
Floral tube length (mm)	72–80	62–81
Corolla limb length (mm)	13–17	14
Floral tube width at throat (mm)	5.5–7.0	3.0–6.0
Floral tube width at calyx (mm)	2.0–3.0	1.5–2.0
Calyx length (mm)	13–19	14–16
Calyx width (mm)	4.5–6.0	5.0–7.5

Fig. 3). *Nicotiana fatuhivensis* has been mostly collected from sea cliffs, but also from inland cliff environments (Wagner & Lorence 2008).

These two taxa are morphologically distinctly different. The Smithsonian Institution's *Flora of the Marquesas* project lists *N. fatuhivensis* as a Marquesan endemic species (Wagner & Lorence 2008). It is concluded from these data that *N. fatuhivensis* should be treated as a separate species and not as a variety of *N. fragrans*.

Conclusions

There are three distinct taxa of *Nicotiana* in the South Pacific:

N. forsteri Roem. & Schult.

Synonym: *N. debneyi* Domin

Distribution: Eastern Australia (New South Wales, Queensland), Lord Howe Island (Australian territory), New Caledonia (Grande Terre, Loyalty Islands also recorded on Île Améré (Botany Isle)).

Note: Nicolson and Fosberg (2004) list Norfolk Island but there is no other evidence that it has ever been found there. Orchard (2006) in the *Australian Plant Census* lists *N. debneyi* as naturalised on Lord Howe Island, however this is an error. It is listed as a native species by Green (1993, 1994) and Rodd and Pickard (1983).

N. fragrans Hook.

Distribution: New Caledonia (recorded on the Isle of Pines, Loyalty Islands and Grande Terre) and the Kingdom of Tonga (Island of Tongatapu).

N. fatuhivensis F.Br.

Distribution: Marquesas Islands (recorded on eight of the twelve islands including Fatu Hiva, Moho Tani, and Tahuata).

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Figure 3. *Nicotiana fragrans* Hook. **a.** *N. fragrans* growing wild in fissures in a beachside rock, Grande Terre, New Caledonia (photo P.Y. Ladiges). **b.** Beachside habitat of (a) (photo P.Y. Ladiges). **c.** *N. fragrans*, *Y. Pillon 441*, 15.vii.2006, Dranin, Maré, Nouvelle-Calédonie, calcareous cliff (NOU) —the woody caudex is clearly shown. **d.** close view of flowers of (c).

Specimens examined

Nicotiana fotuhivensis: MARQUESAS ISLANDS. Mohotani Island, Partie méridionale, près du sommet de l'île. P.A. *Schäfer 5705*, 19.viii.1975 (K); Mohotani Island, Versant oriental dans la partie centrale, *P.A. Schöfer* S340, 18.iii.1975 (K); Fatu Iva Island, Ouia, lieu-dit Ahoana, *P.A. Schäfer* 5828, 22.ix.1975 (K); Tahuata Island, Sentier de Hanateio à Hapatoni, lieu-dat Fae Namou au S du col., *P.A. Schäfer* 5994, 26.xi.1975 (K).

Nicotiono forsteri: **AUSTRALIA.** Rockingham 8ay, Queensland, *Dallochy*, 1868 (K). **LORD HOWE ISLAND.** Lord Howe Island, *Copt. J.D. McCornish 55*, 1936 (K); South-east lower slopes of Malabar, *P.S.Green 1545*, 11.xi.1963 (K); West foot of Mt Lidgebird, *I.R. Telford 70B9*, 23.x.1978 (C8G 7809873). **NEW CALEDONIA.** Plant cultivée à Nouméa, *M.G. Boumonn-Bodenheim 16051*, 10.i.1952 (NY); New Caledonia, *I. Fronc B06*, (NY); Nouvelle Calédonie, *M. Poncher*, 1870 (K); 8otany Isle, New Caledonia, *J.R. & G. Forster*, 29–30.ix.1774 (8M). .

Nicotiano frogrons: **NEW CALEDONIA.** Isle of Pines; seaside forest near Kuto, *Gordon McPherson 599B*, 17.xi. 1983 (MO); Atoll von Ouvéa, *A.U. Döniker 2210*, 27.ix.192S (K); Isle of Pines, rocks by seashore, *John Mc Gillivray 859*, x.18S3 (K); Isle Of Pines, New Caledonia, *Milne, x.*19S3 (K). **TONGA.** Tongatapu, Fangaveha on the southern coast of the island, *T.G. Yuncker 16252*, 7.vi.19S3 (NY, 8M); Tus. Tongatabu. Au von der 8randung benetrten Felsen der Südküste, selsen. *Luerssen 3/B0 Groeffe leg. 1360* (K); Tongatapu, Keleti beach on the west coast of the island, *Art Whistler 6540*, 28.vii.1988 (8M).

References

Aoki, S. and Ito, M. (2000). Molecular phylogeny of *Nicotiono* (Solanaceae) based on the nucleotide sequence of the *matK* gene. *Plont Biology* **2**, 316–324.

8rown, F.B.H. (1935). Flora of Southeastern Polynesia III Dicotyledons. *Bernice P Bishop Museum Bulletin* **130**, 261–262.

8urbidge, N.T. (1960). The Australian species of *Nicotiono* L. (Solanaceae). *Austrolion Journol of Botany* **8**, 342–378.

Chase, M.W., Knapp, S., Cox, A.V., Clarkson, J.J., 8utsko, Y., Joseph, J., Savolainen V. and Parokenny, A.S. (2003). Molecular Systematics, GISH and the origin of hybrid taxa in *Nicotiano* (Solanaceae). *Annols of Botony* **92**, 107–127.

Clarkson, J.J., Knapp, S., Garcia, V.F., Olmstead, R.G., Leitch, A.R. and Chase, M.W. (2004). Phylogenetic relationships in *Nicotiono* (Solanaceae) inferred from multiple plastid DNA regions. *Moleculor Phylogenetics ond Evolution* **33**, 75–90.

Goodspeed, T.H. (1933). Chromosome number and morphology in *Nicotiona* VI: chromosome numbers of forty species. *Proceedings of the Notionol Acodemy of Science USA* **19**, 649–653.

Goodspeed, T.H. (19S4). The Genus *Nicotiono*: origins, relationships and evolution of its species in the light of their distribution, morphology and cytokinetics. Chronica Botanica Company: Massachusetts.

Green, P.S. (1993). Notes relating to the floras of Norfolk & Lord Howe Islands, IV. *Kew Bulletin* **48**, 307–32S.

Green, P.S. (1994). *Norfolk Islond ond Lord Howe Islond.* In A.J.G. Wilson (ed), *Floro of Austrolio*, vol. 49, pp. 294–296. Australian Government Publishing Service: Canberra.

Heine, H. (1976). *Flore de la Nouvelle-Colédonie et Dépendonces*. Muséum National d'Histoire Naturelle: Paris.

Horton, P. (1981). A taxonomic revision of *Nicotiana* (Solanaceae) in Australia. *Journol of the Adeloide Botonic Gordens* **3**, 1–56.

Intrieri, M.C., Muleo, R. and Buiatti, M. (2008). Phytochrome A as a functional marker of phyletic relationships in *Nicotiono* genus. *Biologio Plontorum* **52**, 36–41.

Jaffré, T., Morat, P., Veillon, J.-M., Rigault, F. and Dagostini, G. (2001). *Compostion ond chorocteristics of the notive flora of New Coledonio.* Institut de recherche pour le Développement (IRD): Noumea

Knapp, S., Chase, M.W. and Clarkson, J.J. (2004). Nomenclatural changes and a new sectional classification in *Nicotiona* (Solanaceae). *Toxon* **53**, 73–82.

Komarnitsky, S.I., Komarnitsky, I.K., Cox, A., and Parokonny, A.S. (1998). Molecular phylogeny of the nuclear 5.8S ribosomal RNA gene in 37 species of *Nicotiono* genus. *Russian Journol of Genetics* **34**, 727-733.

Morat, P., Jaffré, T. and Veillon, J.-M. (2001). The flora of New Caledonia's calcareous substrates. *Adansonio* **23**, 109–127.

Nicolson, D.H. and Fosberg, F.R. (2004). *The Forsters ond the botony of the second Cook expedition (1772–1775).* A.R.G. Gantner Verlag, Liechtenstein.

Olmstead, R.G., 8ohs, L., Migid, H.A., Santiago-Valentin, E., Garcia, V.F. and Collier, S.M. (2008). A molecular phylogeny of the Solanaceae. *Toxon* **57**, 1159-1181.Orchard, T. (2006). *Austrolion Plont Census*. Council of Heads of Australian Herbaria (CHAH): Canberra.

Purdie, R.W., Symon, D.E. and Haegi, L. (1982). Solanaceae. In A.S. George (ed.) *Floro of Austrolio*, vol. 29, pp. ??. Australian Government Publishing Service: Canberra.

Rodd, A.N. and Pickard, J. (1983). Census of Vascular Flora of Lord Howe Island. *Cunninghomio* **1**, 267–280.

Roemer, J.J. and Schultes, J.A. (1819). *Coroli o Linné equitis Systemo vegetabilium secundum closses ordines genero species*, vol. 4. J.G. Cottae: Stuttgardt.

Wagner, W.L. and Lorence, D.H. (2008). *Flora of the Morquesos Islonds.* Smithsonian Institution and the National Tropical Botanical Garden, Hawaii. Accessed 9 June 2009. <http://botany.si.edu/Pacificislandbiodiversity/marquesasflora/>

Wheeler, H.-M. (193S). Studies in *Nicotiono* II: a taxonomic survey of the Australasian species. *University of Colifornio Publicotions in Botony* **18**, 45–68.

Wheeler, H.-M. (194S). A contribution to the cytology of the Australian – South Pacific species of *Nicotiona*. *Proceedings of the Notionol Acodemy of Science USA* **31**, 177–18S.

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Allan, H.H. (1961). *Flora of New Zealand*. R.E. Owen, Government Printer: Wellington.

Ahti, T. and Kashiwadani, H. (1984). 'The lichen genera *Clodia*, *Cladina* and *Cladonia* in southern Chile'. In H. Inoue (ed.), *Studies on the cryptogams of southern Chile*, pp. 125–149. Kenseisha Ltd: Tokyo.

Brummitt, R.K. and Powell, C.E. (1992). *Authors of plant names*. Royal Botanic Gardens: Kew.

Jarman, S.J. (1975). *Experimental taxonomy on the family Epacridaceae*. PhD thesis, The University of Tasmania, Hobart: Tasmania.

Pickett, J.W., Smith, N., Bishop, P.M., Hill, R.S., Macphail, M.K. and Holmes, W.B.K. (1990). A stratigraphic evaluation of Ettingshausen's New England Tertiary plant localities. *Australian Journal of Earth Sciences* **37**, 293–303.

Swofford, D.L. (2000). *PAUP. Phylogenetic analysis using parsimony (version 3.1.1.)* Illinois Natural History Survey: Champaign, USA.

Walsh, N.G. (1994). 'Poaceae'. In N.G. Walsh and T.J. Entwisle (eds), *Flora of Victoria*, **Vol. 2**, pp. 356-627. Inkata Press: Melbourne.

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